

**THE PROMOTION OF REGULAR EXERCISE BEHAVIOR AMONG
SEDENTARY EMERGING ADULTS BASED ON
SOCIAL COGNITIVE THEORY**

DISSERTATION

**Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University**

By

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ABSTRACT

As the obesity epidemic continues to sweep through industrialized societies contributing to the myriad chronic diseases that plague us today such as cardiovascular disease, Type II Diabetes and certain cancers. With estimates that two-thirds of the U.S. adult population is considered either overweight or obese and the predicted yearly \$300 billion the U.S. will be spending on medical costs related to obesity by the year 2020, researchers are challenged with finding solutions to prevent and reverse obesity's impact. Increasing levels of physical activity is one approach that deserves our attention. There is cause for concern as more than 50% of U.S. adults are classified as insufficiently active or inactive despite the scientific evidence of the overall benefits of maintaining a physically active lifestyle. While rates of physical activity are known to decline with age the greatest reduction occurs during adolescence with a lowered sustained rate during young adulthood as this population is matriculating into family and work roles or continuing into higher education. Intervening with the emerging adult population presents a unique opportunity to attempt to increase levels of physical activity during a time when lifelong habits are beginning to be established. This study examined the effects of a randomized control trial 8-week Social Cognitive Theory based behavioral and exercise program designed to increase planned physical exercise among emerging adults compared to a standard care group. There were 32 participants enrolled in the intervention that were randomly assigned to two groups. The treatment group received

the Social Cognitive Theory based behavioral strategy sessions and supervised exercise sessions. The standard care group received free unlimited access to the University Wellness Center. The total sample size was 26 with 13 participants in each group. Each group completed questionnaires designed to measure their levels of physical activity behavior and SCT constructs along with measures of fitness for upper body strength and cardiovascular fitness. The results from this study indicated that increases in moderate physical exercise was achieved to the level of ACSM recommendations of 150 minutes per week by the treatment group increasing from approximately 23 min/wk at baseline to 156 min/wk at 8-week follow-up. An increase in friend social support and self-regulation was also reported for the treatment group. Fitness outcomes were also improved as treatment group participants improved their weight status, cardiovascular health and upper body muscular endurance.

DEDICATION

To my wife Danielle for her unwavering support and love.

To my children Benjamin and Nicole for reminding me what's most important in life.

To Dan and Carol Evans who supported the family while I was away.

To Mom and Dad for the foundation they established.

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CHAPTER 1

INTRODUCTION

Problem Statement

In the landmark report *Physical Activity and Health: A Report of the Surgeon General* (USDHHS, 1996) a scientific consensus was reached on the benefits of physical activity on overall mortality, CVD, Type 2 diabetes, cancer, obesity, mental health, the quality of life, risk of sudden death and musculoskeletal injury, osteoarthritis and bone health. According to data reported by the CDC in 2007 using the Behavioral Risk Factor Surveillance Survey, only 48.8% of U.S. adults are achieving recommended amounts of physical activity. Those considered insufficiently active reaching 37.7% and the inactive population reported at 13.5%. Additionally, 24.1% of the U.S. population in 2007 reported no leisure-time physical activity during the previous month. This data is cause for concern with more than 50% of U.S. adults classified as insufficiently active or inactive despite the scientific evidence of the overall benefits of maintaining a physically active lifestyle. While rates of physical activity are known to decline with age, the greatest reduction occurs during adolescence with a lowered sustained rate during young adulthood as this population is matriculating into family and work roles or continuing into higher education (Caspersen et al., 2000). On December 2, 2010 the U.S. Department of Health and Human Services announced its *Healthy People 2020* campaign

and again ranked physical activity as a leading health indicator. The current established physical activity objectives for adults are presented below:

- **PA-1:** Reduce the proportion of adults who engage in no leisure-time physical activity.
 - Target: 32.6 percent.
 - Baseline: 36.2 percent of adults engaged in no leisure-time physical activity in 2008.

- **PA-2:** Increase the proportion of adults who meet current Federal physical activity guidelines for aerobic physical activity and for muscle-strengthening activity.
 - PA-2.1 Increase the proportion of adults who engage in aerobic physical activity of at least moderate intensity for at least 150 minutes/week, or 75 minutes/week of vigorous intensity, or an equivalent combination.
 - Target: 47.9 percent.
 - Baseline: 43.5 percent of adults engaged in aerobic physical activity of at least moderate intensity for at least 150 minutes/week, or 75 minutes/week of vigorous intensity, or an equivalent combination in 2008.

 - PA-2.2 Increase the proportion of adults who engage in aerobic physical activity of at least moderate intensity for more than 300 minutes/week, or more than 150 minutes/week of vigorous intensity, or an equivalent combination.
 - Target: 31.3 percent.
 - Baseline: 28.4 percent of adults engaged in aerobic physical activity of at least moderate intensity for more than 300 minutes/week, or more than 150 minutes/week of vigorous intensity, or an equivalent combination in 2008.

 - PA-2.3 Increase the proportion of adults who perform muscle-strengthening activities on 2 or more days of the week.
 - Target: 24.1 percent.
 - Baseline: 21.9 percent of adults performed muscle-strengthening activities on 2 or more days of the week in 2008.

 - PA-2.4 Increase the proportion of adults who meet the objectives for aerobic physical activity and for muscle-strengthening activity.
 - Target: 20.1 percent.
 - Baseline: 18.2 percent of adults met the objectives for aerobic physical activity and for muscle-strengthening activity in 2008.

As the rate of physical activity declines with age an inverse relationship with obesity rate exists. According to 2006 data from the Center for Disease Control and Prevention utilizing the Behavioral Risk Factor Surveillance System, trends in the prevalence of obesity among U.S. adults aged 18 and older had increased to 34% (Ford 2011) and has remained relatively stable at 34.9% in 2011-2012 (Ogden et al., 2014). The CDC reports that in 2008 medical costs associated with obesity related diseases are estimated at \$147 billion dollars (Finkelstein et. al., 2009). This inverse relationship between physical activity and obesity rates is a recipe for economic disaster and poses serious repercussions regarding the future health and stability of nations. In an effort to combat the deleterious effects of obesity, the American College of Sports Medicine and the Centers for Disease Control and Prevention have established guidelines regarding necessary rates of physical activity for the population of adults. The most recent Position Stand by the ACSM indicates that in order to prevent weight gain 150 – 250 minutes per week of moderate intensity physical activity is necessary and for weight loss, greater than 250 minutes per week may be required coupled with moderate diet restriction (Donnelly et al., 2009).

Physical Activity Rates of Emerging Adults

Two subsets of the adult population include college students who represent approximately 20.4 million students enrolled in higher education institutions in the U.S. (NCES, 2009) and those emerging adults who transition into the labor force upon high school graduation. Both of these groups represent populations undergoing a transition phase of life from adolescence to adulthood and may present a pivotal time point when

lasting health behavior patterns are established. Although at the time of this writing no data could be identified specifically targeting the emerging adult not enrolled in higher education, there exists some research for the university student population. According to the American College Health Association National College Health Assessment II Reference Group Executive Summary – Fall 2011, 52.6% of college students were not meeting physical activity guidelines for adults established by the American College of Sports Medicine and the American Heart Association of achieving moderate-intensity aerobic exercise for at least 30 minutes on 5 or more days per week or vigorous-intensity aerobic exercise for at least 20 minutes 3 or more days per week. From this same report, overweight/obesity rates for college students based on body mass index were 24.42%. Kasparek et al. (2008) demonstrated that those students who entered college with a BMI greater than 25 gained two times as much weight as those with a healthy BMI emphasizing the need for interventions targeting at-risk groups. In concurrence with *Healthy People 2010*, the American College Health Association established a campaign titled *Healthy Campus 2010* which established physical activity as the number one leading health indicator for college students and set forth the following objectives:

- Increasing the number of college students who receive information from their college about physical fitness and activity
 - baseline=32.3%; target=55%
- Increase number of college students exercising moderately
 - baseline=40.9%; target=55%
- Reduce proportion of adolescent and college students who are overweight and obese
 - baseline=35.8%; target=16%

From this report it is suggested that strategic plans for increasing rates of physical activity need developing, measurement issues need resolved, and the efficacy of health and physical education programs in higher education need further evaluation. Based on the evidence that obesity rates are rising and physical activity rates are lowered during a time of significant transition for the emerging adult, interventions targeting this population are warranted in an effort to establish healthful practices that can be sustained long term.

Physical Activity Determinants in Emerging Adults

Based on the review of literature for this dissertation evidence supports the targeting of psychosocial correlates in their ability to significantly impact physical activity behavior among emerging adults. Multiple systematic reviews on correlates of physical activity in young adults and college students support this determination. In a review by Keating et al. (2005) multiple social cognitive constructs emerged as impacting physical activity behavior. Self-efficacy was reported as highly significant along with social support from peers and family. Evidence also suggested that college students were motivated more by body-related concerns rather than long-term health promoting factors. A review of physical activity behavior in adolescents and young adults by Nahas et al. (2003) revealed that self-efficacy was highly correlated with physical activity and the most recognized perceived barriers included lack of time (competing demands) which necessitates self-regulatory skill training, lack of money, minimal access to facilities, lack of social support, and lack of enjoyment. Data from NHANES III (Dowda et al., 2003) which represented young adults aged 18 to 30 identified demographic and social factors as central determinants of physical activity. In 2002, Kahn et al. investigated the

effectiveness of interventions to increase physical activity and reported that college-based health education and physical education interventions generally demonstrated increased rates of physical activity during the intervention, however follow-up showed reduced levels. Currently, insufficient evidence exists to establish a conclusion on the long-term impact of college-based physical activity interventions.

Social cognitive determinants in the review of literature for this dissertation identified consistent positive correlations with physical activity among four salient constructs. Self-efficacy emerged as the most significant contributor in 13 of 18 studies. Social support from friends appears more impactful on the college student population as many college students are away from home thus relying less on family support however this necessitates further investigation. Self-regulation and outcome expectancy value were the other two psychosocial constructs demonstrating significant positive associations with physical activity behavior among emerging adults.

Physical Activity Interventions in Emerging Adults

During the investigation of literature on physical activity interventions among emerging adults it became evident that research among this population is inadequate. At the time of this review only five interventions were identified and all targeted students enrolled in higher education. No single intervention was recognized as investigating the non-student population. While clearly further research is warranted, those viable studies identified can provide some general conclusions. Four of the five interventions were theoretically based on Social Cognitive Theory with self-efficacy, social support, self-regulation, and outcome expectancy emerging as targeted constructs. Two (TIGER and

Fitness for Living) of the five interventions utilized objective measures of physical activity behavior adding additional validity to the research. Only one study (Project GRAD) reported on any substantial long-term follow-up and reported significant declines in rates of physical activity similar to baseline measurements. Of increasing interest is the dose-response relationship. Two of the studies (TIGER and Project TEAM) reported meeting ACSM guidelines for physical activity behavior during the intervention but without follow-up data the possibility to identify the sustainability of such an intervention and determine a dose-response relationship is not possible.

Theoretical Foundation

In a systematic review of the effectiveness of interventions to increase physical activity, Kahn et al. (2002) reported that theory-based programs demonstrate strong evidence in increasing physical activity rates provided the intervention is designed appropriately for the target population. In this same review, insufficient evidence exists on the effectiveness of college-based health and physical education interventions to increase physical activity among college students long-term. Baranowski et al. (1998) reviewed the results of physical activity interventions and their ability to predict behavior based on theoretical foundations by changing behavioral constructs and concluded with recommendations for future research. In a review of 25 physical activity intervention studies and 45 correlational studies the authors commented that generally the results showed minimal if any impact on changing physical activity behavior. Those studies that did show some effect included when the population were volunteers already motivated to be active or changing the PE curriculum which naturally would increase behavior during

the time of the course. What was not evident was what about the programs were producing the changes and how could levels of physical activity be increased or maintained outside of the intervention environment. As a result the researchers suggest that the mediating variable framework be employed to assist in understanding the association between theoretical variables and outcomes and how the intervention affects the mediating variables. Baranowski et al. (1998) further reviewed studies to assess the maximum level of predictability in physical activity interventions reported as R^2 values and suggested a maximum level exists because of the complexities of human behavior and the influence of genetics. In those studies reviewed the R^2 values were often low ($R^2 < .30$) however some were able to exceed this benchmark. The primary reason given for these low levels was directed towards a lack of objective measurement. It was suggested that research focus should emphasize theoretical considerations followed by interventions using adequate measures with theory that demonstrates an ability to predict physical activity behavior at a level consistently above $R^2 = .30$. The authors suggest progression of the research from basic behavioral research emphasizing concepts, methods, and measures to understand the behavior (i.e. determinants); to mediator research that tests the variables identified in basic research; to interventions that utilize those properties shown to be efficacious from the mediation research. The authors then suggest three major research recommendations:

1. Conduct more basic research to understand determinants of physical activity behavior comparing theoretical models, integrating multiple constructs, focus on specific types of activities among varied populations.

2. Develop programs that establish change in mediators focusing on cognitive constructs, investigate existing programs that induce change (i.e. fitness programs), and explore differences between non-volunteers and volunteers.
3. Intervention research must cautiously comprehend the mediating pathways through identification of those variables predictive ability ($R^2 > .30$), develop valid and reliable measures that are population specific, conduct power calculations, and submit data from prior interventions for mediation analysis.

Social Cognitive Theory as developed and defined by Bandura involves a reciprocal relationship among behavioral, personal, and environmental factors where a change in one component can have a significant impact on the other factors. These interacting psychosocial forces then in turn affect behavior. The central construct for behavioral change in Social Cognitive Theory that has emerged is self-efficacy, generally defined as a persons' cognitive belief in their ability to perform a certain behavior (Bandura, 1977). Bandura posits that self-efficacy is influenced by four major sources of information, the most important being *enactive mastery experiences* where repeated reinforcement or repetition of the behavior enables the individual to cognize the effort necessary to repeatedly succeed with the behavior.

Rationale for the Study

Based on the review of literature conducted on emerging adults and physical activity behavior it is clear more research is needed. Yet to be identified in the literature is a thorough investigation of the non-university emerging adult with respect to physical activity behavior and of the few interventions that have been conducted with college students, evidence is insufficient to establish their effectiveness. While a small number of interventions focusing on the college student population have attempted to change physical activity behavior through social cognitive means, only one study by Sailors et al. (the TIGER study, 2010) provided adequate *enactive mastery experience* by requiring participants to exercise aerobically for 30 minutes three times per week at an intensity of 65% to 85% of their age and gender specific predicted maximum heart rate reserve monitored objectively with the Polar E600 heart rate monitor thus allowing for the assessment of adherence and dose. While the objective measurement of exercise in this study is encouraging, further analysis of the affect on psychosocial mediators or long-term adherence rates from the TIGER study is currently unavailable. The dose-response necessary to maintain permanent exercise behavior change may be highly individual and elusive but should be evaluated in further studies. With more than 50% of college students not meeting recommended guidelines for physical activity and the lack of research on an entire population of emerging adults not attending higher education the design, implementation, impact, and evaluation of behavioral based exercise interventions among this group is warranted.

Definition of Terms

Emerging Adulthood

Emerging adulthood is neither adolescence nor young adulthood but a distinct time frame focusing on ages 18 through the late twenties of semi-autonomy with independent exploration and possibility while much of the future remains yet undecided (Arnett, 2000).

Operational definition: For this study emerging adulthood was defined as any person aged 18-30 who meets the inclusion criteria for this study.

Physical Activity

Physical activity is defined as “any bodily movement produced by skeletal muscle that results in energy expenditure” (Caspersen, Powell, and Christenson, 1985). This study incorporated a specific subset of physical activity termed exercise which is delineated by intensity.

Exercise: Exercise can be defined as “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness” (ACSM’s Guidelines for Exercise Testing and Prescription, 7th ed., page 3).

Moderate Physical Activity: Moderate physical activity can be defined as exercising at a relative intensity between 40-59% of the heart rate reserve (ACSM’s Guidelines for Exercise Testing and Prescription, 7th ed.).

Vigorous Physical Activity: Vigorous physical activity can be defined as exercising at a relative intensity between 60-84% of the heart rate reserve (ACSM's Guidelines for Exercise Testing and Prescription, 7th ed.).

Operational definition: Physical activity was measured using the 7-d PAR questionnaire (Petosa, 1993) which asks participants to recall the type of moderate or vigorous physical activity performed to enhance health and fitness, the number of minutes, and whether it was planned or not over the previous seven days.

Cardiorespiratory Fitness

Cardiorespiratory fitness is defined as the ability to perform dynamic exercise using larger muscle groups at moderate-to-high intensity for extended periods (ACSM 2006). The accepted criterion measure of cardiorespiratory fitness is maximal oxygen uptake (VO_{2max}) and is defined as the rate of oxygen uptake by the working muscles during exercise and reflects the ability of the heart, blood, and lungs to deliver that oxygen (ACSM, 2006). If the direct measurement of VO_{2max} is not feasible due to lack of medical personnel on site the American College of Sports Medicine recommends the utilization of submaximal exercise tests which estimate VO_{2max} based on heart rate response or time to volitional fatigue.

Operational definition: As participants in this study were all considered sedentary the Rockport One-Mile Fitness Walking test was conducted to estimate cardiorespiratory fitness. The following prediction equation (Kline et al., 1987) was used to estimate VO_{2max} :

- $VO_{2max} = 132.853 - (0.0769 \times \text{weight in lbs.}) - (0.3877 \times \text{age in years}) + (6.315 \times \text{gender; 1=male, 0=female}) - (3.2649 \times \text{time in minutes}) - (0.1565 \times \text{HR, bpm})$

Muscular Endurance

Muscular endurance is defined as the ability of a muscle to maintain submaximal force levels for extended periods of time or multiple repetitions (Heyward, 2006).

Operational definition: The push-up test to assess upper-body muscular endurance was used in this study based on ACSM (2006) recommendations. An age-gender norms chart was used then to categorize participants (CSEP, 2003).

Social Cognitive Theory

Social Cognitive Theory is a theory describing human behavior in a way that proposes a reciprocal relationship among behavioral, personal, and environmental factors that interact and affect each other psychologically in a way that shapes peoples actions (Bandura, 1986). The constructs under investigation in this study included self-efficacy, self-regulation, social support and outcome expectancy value.

Self-efficacy

Exercise self-efficacy can be described as a person's perceived ability to overcome barriers to exercising regularly (Bandura, 1986).

Operational definition: The exercise self-efficacy instrument used in this study was the Self-Efficacy for Exercise Questionnaire based on recommendations by

Bandura and developed by researchers from Stanford University which asks participants to rate their confidence level in exercising regularly relative to certain common barriers for the next six months on a scale from 0 – 100% (Garcia and King, 1991). A composite score is recorded by averaging the responses to the items.

Self-regulation

Self-regulation includes “self-monitoring of health-related behavior and the social and cognitive conditions under which one engages in it; adoption of goals to guide one’s efforts and strategies for realizing them; and self-reactive influences that include enlistment of self-motivating incentives and social supports to sustain healthful practices” (Bandura, 2005, p. 246).

Operational definition: An instrument developed by Petosa, P.S. (1993) was used to assess self-regulatory strategies for maintaining exercise behavior. This instrument asks participants to recall over the past four weeks various techniques used to help them exercise on a regular basis utilizing a 5-point Likert scale ranging from “never” to “very often.”

Social support

Social support for exercise recognizes the role family and friends have in impacting one’s exercise behavior. This social network can have significant impact on shaping a person’s

behavior through modeling and reinforcement and it is the participant's interpretation of this support that influences exercise behavior.

Operational definition: Social support was assessed in this program using the instrument developed by Sallis et al. (1987). This instrument asks participants to recall over the past three months how often family or friends offered encouragement or created opportunities to for the participant to become more physically active utilizing a 5-point Likert scale ranging from “none” to “very often.”

Outcome expectancy value

Outcome expectancy value can be described as the value a person places on engaging in a behavior. If a person places a high value in attaining a certain goal they will be more inclined to extend the necessary effort to accomplish the task even in the presence of barriers and competing interests. People will choose to perform activities that capitalize on positive outcomes or minimize negative ones (Glanz et al., 2002). Outcome expectancy value for exercise then is the importance placed on the incentives and rewards received from engaging in exercise.

Operational definition: An instrument developed by Steinhardt et al. (1989) was utilized to assess outcome expectancy value for exercise. This instrument asks participants to rate their level of agreement with reasons or expected positive outcomes to why they engage in exercise activities.

Purpose of the Study

The purpose of this study was to examine the effects of an 8-week Social Cognitive Theory based behavioral and exercise intervention designed to increase planned physical exercise among emerging adults compared to a standard care group. A Social Cognitive Theory based behavioral intervention was administered along with supervised exercise sessions. The SCT based behavioral intervention was designed to specifically target the constructs of self-efficacy, family and friend social support, self-regulation and outcome expectancy value. The supervised exercise sessions were designed to reduce body weight, improve cardiorespiratory fitness and improve upper-body muscular endurance. Evaluation was conducted to measure rates of physical activity, change in SCT construct scores, change in fitness outcomes and the mediating effects of the SCT constructs on physical activity rate. It is hypothesized that the promotion of planned regular exercise behavior among sedentary emerging adults at a point of critical life transition will provide sufficient enhancement of physiological and psychosocial traits which will support long-term adherence of planned exercise behavior.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to systematically investigate the existing literature regarding physical activity behavior specifically among the emerging adult population. The chapter begins with a brief introduction of the salient characteristics of this specific target population. Presented next is an identification of the patterns of physical activity behavior followed by a review of those determinants recognized as having an association with those patterns. With rates and determinants established, further investigation of interventions targeting physical activity behavior within this population will be explored. Following the examination of interventions the next section of this review of literature will feature a thorough investigation of Social Cognitive Theory and those constructs from the theory which demonstrate the greatest evidence for impacting physical activity behavior among the emerging adult. Lastly, an examination of the various measurement tools often employed in physical activity behavior research will be examined. From this literature review the extent to what researchers have already investigated will have been established and any gaps in the literature identified. These outcomes then provide the foundation for the design, implementation, and evaluation of future physical activity behavior interventions for the emerging adult.

Emerging Adulthood

In an article titled *Emerging Adulthood: a Theory of Development from the Late Teens through the Twenties*, Jeffrey Arnett (2000) contends that “emerging adulthood is neither adolescence nor young adulthood but is theoretically and empirically distinct from them both.” This time period focuses on the age range from 18 through the late twenties for those of industrialized societies and is characterized as a time of significant change for many where multiple opportunities exist and the future remains rather undefined. It is during this time where more long-term behavioral patterns are being shaped. Arnett is careful to point out however that emerging adulthood is impacted by cultural norms, and not all young people may be provided this opportunity for independent discovery. The estimated median age of first marriage in the U.S. in 2011 was 28.7 for men and 26.5 for women compared to 1960 data indicating median age was 22.8 for men and 20.3 for women (U.S. Bureau of Census, 2011). According to the National Center for Education Statistics (2009) between 1999 and 2009, enrollment in post-secondary education increased 38 percent, from 14.8 million to 20.4 million and the percentage of 18 to 24 year-olds enrolled in college rose from 36 percent in 1999 to 41 percent in 2009. This trend for 18 to 24 year-olds is expected to continue with an estimated increase of 13% by 2020 (NCES, 2011). This normative shift in continued education and delayed onset of marriage postpones the time for this population to adopt adult roles. Arnett (2000) further describes emerging adulthood as a time of “semi-autonomy” where some independence is gained while other responsibilities remain with parents, college administrators, or other adults and identifies three criteria the emerging

adult describes in making the transition to adulthood: self responsibility, independent decision making and financial independence, much of this now being achieved in the late twenties. This transition period of emerging adulthood represents a distinct time frame for identity shaping, exploration, and possibility (Arnett, J., 2000).

Patterns of Physical Activity Behavior

To investigate the descriptive literature regarding physical activity patterns and young adults, a comprehensive computerized database search was conducted using PsychInfo (38 matches), MEDLINE (36 matches), PubMed (43 matches), and an advanced multi-database search (127 matches), using the keywords: physical activity, trends, rates, patterns; college students, young adults, emerging adults. Secondly, a careful examination of the reference lists of those articles that were retained was also conducted. Inclusion criteria for review included the following: peer reviewed research articles which incorporated the English language; published between 1990 and 2014; population under study described as young or emerging adults or students enrolled in college/university; with physical activity or exercise as the target behavior. As a result of the inclusion criteria 20 articles have been retained and reviewed for their relevance to patterns of physical activity behavior among emerging adults.

In a longitudinal cohort study of 640 Canadian adolescents aged 12 – 15 years, Kwan et al. (2012) sought to examine physical activity patterns based on educational trajectory and gender. The participants were interviewed biannually through the age of 27 years. Leisure-time physical activity was measured via questionnaire which asked respondents to identify from a list of 20 activities those they had participated in and for

how long over the past three months. Total energy expenditure was then estimated from the assigned MET levels for each activity. Test-retest reliability and criterion validity were referenced. Educational trajectory for transition into early adulthood was measured by asking respondents whether or not they attended post-secondary school after high school. Participants were then categorized as either post-secondary (PS) or non-post-secondary (non-PS). Overall, the results showed a 30% decrease in physical activity rates for men and a 17% decrease in physical activity rates for women across the 12-year period. The sharpest decline was found for men transitioning into college/university while women showed only a modest decrease during this time but the women in this study were far less active than men at baseline. The authors suggested that girls' physical activity rates may see a greater decline prior to adolescence. The authors concluded that both the university and workplace settings are ideal for physical activity intervention among this population of young adults and those programs should be gender specific and target increasing activity levels for women and prevention of declines in physical activity for men.

Wengreen, H.J. and Moncur, C. M. (2009) conducted a longitudinal observational study called the *Freshmen Health Study* (FHS) examining the associations between physical activity, weight, changes in diet, and BMI among 159 freshmen college students. Convenience sampling methods were utilized during freshmen orientation classes and posting of fliers. Two assessment points occurred; one at the beginning of the semester during the last two weeks of August (2005) and one during the first two weeks of December (2005) prior to final exams. Incentives included a T-shirt and \$10 per data

collection. At each data collection point participants were weighed, measured, and completed a questionnaire regarding health behaviors. No validity or reliability of the instrument was presented. A change in weight greater than or equal to 5% of baseline weight was considered clinically significant. Physical activity was assessed by self-reporting how many days per week participants engaged in moderate or vigorous activities. At the second assessment they were asked how their physical activity now compares to their last six months of high school. Results demonstrated that 23% of participants gained $\geq 5\%$ of their body weight during the study. Average increased weight change was 1.51 lbs. Those who gained greater than 5% of their body weight reported less physical activity during these three months of college than high school. The authors concluded that even this modest amount of weight gain supports the continued efforts of offering intervention strategies for the emerging adult to maintain body weight.

An examination of the frequency and type of self-reported physical activity and the role of information provision in 127,360 college students (85.2% between the ages of 18-24 years) referencing Healthy Campus 2010 objectives were investigated by Mack et al. (2009). Physical activity was assessed using the two questions included in the ACHA-NCHA questionnaire along with one question on information provision. Data from 2004 suggests that 57.8% of college students are not engaging in at least 3d/wk of moderate intensity physical activity and 51.4% do not engage in at least 2d/wk of strength training. Those participants who provided information on physical activity/fitness reported more frequent engagement in strength training and moderate-vigorous physical activity. The authors concluded that informational provision can have an impact on physical activity

trends and that combining informational/community-based initiatives may have a greater impact.

Jung et al. (2008) assessed the stability of physical activity and diet and their relationship to weight changes in 101 first-year college women living on campus using a prospective design with four dietary and four physical activity assessments at baseline, eight weeks, 25 weeks, and 52 weeks. Body composition was assessed using BIA with reliability and validity cited. Physical activity was measured using the Godin Leisure Time Questionnaire with established validity and reliability. Self-reported 3-day food logs mentioned as the 'gold standard' were analyzed using dietary analysis software. Results indicated that the average weight gain at 1-year was 3.08 lbs.; however 34% of the sample lost an average of 5.3 lbs., and 66% gained 7.54 lbs. For change in body fat levels, those who decreased weight also reduced percentage of body fat and those who gained weight added percentage of body fat. Dietary behavior indicated that both groups reduced caloric intake equally during the first year of college while those who lost weight/fat had increased levels of physical activity behavior measured in MET h/wk indicating a strong association between physical activity levels and weight gain during the first year of university among this group of women.

A study focusing on selected health behaviors that influence college student weight change was conducted by Kasparek et al. (2008) on 193 first year freshmen aged 17 to 19 years at Winthrop University who completed an online questionnaire that examined weight changes from baseline to follow-up during the first year of college. The three CDC-YRBS physical activity assessment questions have demonstrated reliability

kappa mean values of 55.2% and were used in this study. To categorize total activity, the 1995 ACSM guidelines for vigorous PA were used (20 min. or more of physical activity at least 3 days/wk for substantial health benefits) with categories described as low (0-1), moderate (2-3) and high (>4). To determine differences in means for BMI and weight change, t-tests were performed and ANOVAs were conducted to compare baseline and follow-up BMI and ungrouped weight change. Descriptive statistics indicated the following about the sample: 77.7% had desirable BMIs, 94.3% were registered for a meal plan, 94.8% lived on campus, 80.8% were white and 87.6% were female. During the six months from baseline to follow-up, 57% reported a weight gain between 1 and 35 pounds with a mean weight gain of 7.1 pounds. Those reporting no weight change were 19.2% and those losing weight composed 23.8% of the sample. The overall sample gained an average of 2.5 pounds and increased their BMI from 23 to 23.51 and noted by the authors as statistically significant. The overweight group gained twice as much weight as the desirable group indicating a greater need for targeting this population in intervention strategies. At follow-up, a gender relationship existed as men were nearly twice that of women to be classified as overweight according to BMI assessment. It could be argued that men were engaging in more muscle building activities during this 6-month time period which would increase their BMI results however further analysis indicated that the percentage of males engaged in moderate and high-frequency strength sessions dropped from 62.5% to 45.9% thus suggesting this rise in BMI is not substantiated by increased muscle mass, but rather fat mass. Results from testing the association between total activity and BMI indicated that those with the lowest amounts of total activity were twice

as likely to be in the overweight BMI group. The most profound finding from this study is that students with a BMI > 25 gained nearly twice as much weight during the 6-month period than did those students who started the study with a desirable BMI. This population of students is at great risk for considerable weight gain during their college years. The authors suggested that classes designed specifically for and limited to this target population be developed to combat this problem.

The American College Health Association (2007) reported results from their National College Health Assessment (NCHA) conducted in spring 2006 which describes patterns of behavior in college students. This questionnaire was designed to gather information on college students' health behaviors, indicators, and perceptions. This survey tool supports the creation of evidenced-based interventions to improve college students' health. For the spring 2006 assessment, 123 North American post-secondary institutions self-selected to participate. The final data set comprised 94,806 students on 117 campuses of which all used random sampling techniques. Of the 117 schools included, 45 were private and 72 were public with enrollment ranging from less than 2,500 students to schools with 20,000 or more. Various geographic regions of North America as well as urban, suburban, and rural schools were also well represented. Sampling procedures involved randomized intact classrooms and randomized Web-based surveying. The ACHA-NCHA survey instrument gathers data on the following characteristics: demographics; health, health education and safety; weight, nutrition and exercise; sexual behavior, perceptions and contraception; alcohol, tobacco and other drug use; and mental/physical health. For purposes of this review on patterns of physical

activity among college students, results from the weight, nutrition and exercise portion of the questionnaire are included. The spring 2006 ACHA-NCHA questionnaire contains five questions assessing weight, nutrition and exercise. For weight the mean BMI was 23.6 for women and 24.7 for men which both are considered healthy as defined by the National Institutes of Health although closely approaching the next category of being overweight (BMI > 25). Nutritionally 7.9% of students reported eating five or more servings of vegetables and fruits daily. For physical activity 28.1% of college students reported no moderate or vigorous activity and 28.6% indicated only being active 1 or 2 days per week. Types of weight loss behaviors engaged in by students in the past 30 days revealed that exercising to lose weight was practiced by 55.2% and dieting was used by 34.5%. Interesting insight into health impediments to academic success and where students receive health-related information and what/who they believe provides the most believable information was presented. Although students reported using parents, the internet, and friends as their top 3 means of obtaining health-related information, they place more trust in health center medical staff, health educators and faculty/coursework which supports the investigation of current curricular programs identifying which components demonstrate a capability of impacting change. Some limitations with regards to the spring 2006 ACHA-NCHA survey instrument include: the utilization of cross-sectional data may describe patterns of association but not infer causality; the institutions that participated self-selected to do so which introduces selection bias; and the data was self-reported by the students. No information regarding the validity or reliability of the survey instrument used was provided. While being mindful of these

limitations these data can provide health promotion professionals evidence-based information when planning health and wellness interventions in college settings.

In a study to examine vigorous physical activity among college students Nelson et al. (2007) analyzed data from the 2001 Harvard School of Public Health College Alcohol Study which included 119 four-year colleges with a sample size of 10,437. Vigorous physical activity was assessed for usual vigorous physical activity in high school and current vigorous physical activity was assessed using two similarly worded questions of self-reported physical activity. Validity and reliability was cited. Results indicated that 52.4% of college students did not meet the criteria for vigorous physical activity and that was a significant increase from 29.3% in high school. Additionally 23.2% did not engage in any vigorous physical activity compared to 13.2% in high school. Males were more likely to be engaged in vigorous physical activity in high school with 51% of students participating in high school athletics (contributing to their higher levels of VPA) whereas only 15% engaged in collegiate athletics.

McCracken et al. (2007) analyzed data from the 2003 BRFSS, a state-based telephone survey using random-digit-dialing to describe the health-risk behaviors of young adults (aged 18-24 years). This particular study focused on the following factors for analysis: smoking, mental health, general health, binge drinking, fruit and vegetable intake, physical activity and weight control activities. For this review, results of physical activity behavior, BMI and weight control activities were reported. Self-reported frequency and duration of moderate and vigorous leisure-time physical activity performed in a usual week served as the physical activity instrument. Reliability and

validity were not reported. Body-mass-index was calculated from self-reported height and weight. Weight control activities were also self-reported. Of the 18,359 respondents, 26% indicated they were students suggesting 74% were not enrolled in higher education. Results indicated the following: 43.2% did not meet CDC recommendations for physical activity; the prevalence of overweight and obesity reached 38.7%; and 80.1% reported an attempt at weight control activities. The authors suggested targeting this population specific to the factors indicated through behavioral modification and educational approaches.

Dinger and Behrens (2006) examined accelerometer-determined ambulatory activity in 454 college students who wore an Actigraph accelerometer for 7 consecutive days to examine college students' patterns of physical activity. Inclusion criteria required the following: participants had to be enrolled for at least 12 academic hours (minimum to be considered a full-time college student); aged 18 – 30 years; and could not be part of an intercollegiate athletic team. Data collection consisted of two separate visits. The first visit involved informed consent, demographic collection, height and weight measurement, and fitting of the accelerometer. At the second visit after seven days, participants returned the accelerometer. Validity of the Actigraph was documented along with acceptable test-retest reliability (ICC=0.80). The Freedson et al. (1998) cut-points were used: light = < 1952 ct/min, moderate = 1952-5724 ct/min, hard = 5725-9498 ct/min, and very hard = > 9498. Results indicated that 4.6% of students met ACSM recommendations for vigorous physical activity and 53% met moderate physical activity guidelines with students being more active during the week than on weekends and

overall, males were more active than females. However when physical activity was assessed for sessions lasting at least 10 minutes, no gender differences emerged. The authors suggest further research should include accelerometer-determined physical activity in a more representative college student sample in other geographic locations as this study was conducted in the south with possibly more opportunity to be active outdoors during the winter months.

Nelson et al. (2006) evaluated 5-year longitudinal and secular trends in moderate-vigorous physical activity, leisure-time computer use and television viewing of 2516 participants involved in Project EAT-II; a follow-up study to Project EAT-I which studied the behavioral, personal, and socio-environmental determinants of weight status and dietary intakes among a large, ethnically diverse (48 % white, 19% black, 20% Asian, 6% Hispanic, 4% Native American) adolescent cohort. Project EAT-II sought to resurvey these participants five years later identifying two cohorts: progression from early adolescence (11-15 years) to mid-adolescence (15-18 years) and progression from mid-adolescence to young adulthood (18-23 years). Questions assessing sedentary behavior and physical activity were adapted from the Godin Leisure-Time Exercise Questionnaire and Planet Health Surveys with validity referenced. Results demonstrated that across the adolescent transition period significant decreases in moderate-vigorous physical activity and increases in leisure-time computer use. For girls transitioning from mid-adolescence to young adulthood their moderate-vigorous physical activity decreased from 5.1 to 3.5 hours/week. Boys showed a delayed decline in moderate-vigorous physical activity from 6.5 to 5.1 hours/week. Leisure-time computer use increased for

boys during transition to young adulthood from 10.4 to 14.2 hours per week. These results suggest that total sedentary time is increasing during adolescent transition and may be a consequence of increased computer use. The authors suggest that future initiatives target reductions in leisure-time computer usage and increased moderate-vigorous physical activity.

A longitudinal descriptive study to examine the trends in moderate-vigorous physical activity and screen time across the transition from adolescence to young adulthood among participants in the National Longitudinal Study of Adolescent Health (Add Health) was conducted by Gordon-Larsen et al. (2004). A multi-geographic sampling frame included 80 U.S. high schools and 52 middle schools at time-point 1 (Wave I) with 13,030 participants having available data for analysis at time-point 2 (Wave III). Physical activity behavior was assessed via self-report and was mentioned as being similar to other self-report measures which have been previously validated. Results indicated from 1995 to 2001 a significant age-related decline in moderate-vigorous physical activity (MVPA) exists with greater than 50% of males failing to engage in five days of MVPA per week in either time period. A reduction in MVPA of 31% existed between time-points. Additionally Hispanic and Black females showed greater disparity with 78.2 % and 79.1 % failing to achieve five bouts of MVPA across either time period, respectively. The authors commented that a majority of adolescents are not achieving five bouts of MVPA per week and the trends continue negatively into young adulthood therefore a greater emphasis is needed during this transition period to

young adulthood to promote physical activity among the inactive and create initiatives to encourage those already meeting guidelines.

Bray & Born (2004) examined 145 first year university students' report of vigorous physical activity during transition from their last 2 months in high school to their first 2 months at university and examined the association between psychological well-being and physical activity during this transition. Data were collected during the ninth week of fall semester from a liberal arts university in Alberta, Canada. Vigorous physical activity was measured using a questionnaire developed from the 1995 YRBS and the 1995 NCHA-YRBS. Those participating in three or more bouts of activity for 20 minutes or longer per week over the previous eight weeks were considered 'active' and those not meeting that standard were classified as 'insufficiently active'. Psychological well being was measured using the POMS-A and GHQ-28 with construct validity and reliability mentioned as "good". Results indicated a significant decline in vigorous physical activity during transition from 3.32 to 2.68 sessions per week. Of the sample 66% reported sufficient amounts of vigorous physical activity during their last 2 months of high school and declined to 44% during the first 2 months of college. For psychological well-being those reporting positive mood profiles had higher levels of vigorous physical activity. The authors suggested future research needs to explore why vigorous physical activity declines during transition.

Since it appears college students may have considerable discretionary time and how they spend this time influences their physical activity levels, Buckworth and Nigg (2004) analyzed the relationship between physical activity and exercise, and sedentary

behaviors in 493 college students enrolled at a large Midwestern university. The classes were elective conditioning activity courses that contained a 50-minute lecture and three 45-minute exercise labs. Exercise behavior was measured using the NCHRBS and three additional questions on typical exercise duration, frequency in days per week and how long in months exercising at this level. One-week test-retest reliabilities were reported as 0.93, 0.90, and 0.97, respectively. Physical activity history was assessed using the CARDIA Physical Activity Questionnaire for moderate and vigorous physical activity over the previous 12 months with reliabilities reported as 0.81 and 0.89. Sedentary behavior was calculated through three questions regarding the number of hours in a typical week spent watching television and/or videos, studying and using the computer with reliabilities reported as 0.72, 0.62, and 0.87, respectively. Results showed students spent 30 hours per week in sedentary behaviors. Compared to the 1995 NCHRBS, students in this sample had higher levels of exercise behavior with 30.6% engaged in moderate activity compared to 19.5% and 53.2% practicing vigorous activity compared to 37.6%. Gender differences existed with more males watching television/videos and using the computer and self-reporting higher levels of exercise compared to females. Differences by age were found as well with the younger students reporting more days per week stretching and engaging in vigorous physical activity. A correlation between sedentary behaviors and exercise by gender were revealed. For men a negative correlation existed between computer use and vigorous exercise and for women television was negatively correlated with vigorous exercise. The researchers suggested this relationship should be investigated further and that targeting college student

sedentary behavior during their discretionary time may be an avenue for intervention. Although not mentioned by the authors, a possible reason behind why these students reported higher levels of exercise behavior compared to the 1995 NCHRBS could have resulted from the self-selection into a conditioning course, suggesting these students may already be participating in regular physical activity.

Huang et al. (2003) conducted a study to assess the rate of overweight and obesity, dietary habits and physical activity in 736 college students at the University of Kansas in spring of 2001 and spring of 2002 using cross-sectional data. Overweight and obesity status was determined using BMI calculated through self-reported height and weight; dietary habits were assessed using the Berkeley screener which was reported as previously validated; and physical activity was evaluated using 3 questions from the YRBSS. Results from BMI assessment indicated that 21.6% were overweight and 4.2% were obese. Physical activity rates showed students engaging in aerobic exercise 2.8 days per week with males reporting more aerobic exercise than females and overall the sample reported participating in strength training on 2.2 days per week and physical education class 0.9 days per week. The authors suggested that more research is needed on the effects of diet, physical activity, and clinical risks for obesity and the metabolic syndrome in college populations; and that universities are ideal settings for interventions as students are forming lifestyle behaviors.

A preliminary investigation of 31 college students' physical activity patterns using a Yamax Digiwalker pedometer was conducted by Behrens and Dinger (2003). Participants wore the pedometer for seven consecutive days recording steps taken per day.

Results showed that participants averaged 9,932 steps per day with more steps taken during the week than on the weekends. No gender differences were found regarding average number of steps taken per day. The authors suggest future interventions should promote walking tours, intramural sports participation, and educational programming to further increase physical activity levels in college students.

Sparling and Snow (2002) investigated physical activity patterns in recent college alumni and sought to determine potential correlates during this time of post graduation. The possible participants for the study included those students receiving an undergraduate degree from a large southern United States university between the years of 1988 and 1996. Of the 1,000 surveys mailed 367 were returned as useable for the data set. The mean time for the sample since graduation was 6.2 years. All students surveyed had been required to either take a health education course or fitness concepts course while enrolled in university, most of whom took the course their freshmen or sophomore year. No differences in age, height, weight, exercise patterns as a college senior, current physical activity patterns or attitudes towards exercise were found between the two courses so the responses were combined for analysis. A 25-item questionnaire was developed using previously validated questions to assess physical activity in recent college alumni. No values were reported for validity or reliability, although pilot testing was completed. Physical activity was assessed by asking over the past week how many days did the subjects participate in vigorous (sweating and breathing hard for > 20 min.), moderate (walked or biked for > 30 min.) and strength exercises. In addition questions about previous participation in high school sports, exercise patterns in college,

comparison of current physical activity versus college physical activity, attitude toward physical activity and knowing current guidelines for moderate physical activity were also included. Multinomial logistic regression was used to evaluate significant predictors of current activity level. In this sample 55.2% reported earning a high school varsity letter, 66.1% indicated they enjoyed exercise (attitudinal assessment) and 79.4% reported high perceived fitness knowledge. For current physical activity patterns (previous 7 days), 32.7% claimed to engage in vigorous activity on 3 or more days, 6% in moderate-intensity on 5 or more days and 21% participated in resistance exercises 3 or more days. Recall of exercise pattern as a college senior revealed that 43.1% considered themselves regular exercisers (3 or more days/wk), 39.5% as irregular (1-2 days/wk) and 17.4% as non-exercisers (< 1 day/wk). Comparing their current physical activity rate to college physical activity rate, 23% stated being more active now, 33% as about the same, and 44% being less active now. These results indicate that 84.7% of college seniors who self-reported being regular exercisers in college remained active at the time of the survey, while 81.3% who were non-exercisers as college seniors remained inactive at the time of the survey. This finding is important as indications are that physical activity behaviors during the college years may have a sustaining effect post graduation. The regression analysis indicated attitude toward exercise, confidence in setting up a program and exercise status as a college senior served as significant predictors of current physical activity level. Changes in body weight revealed an inverse relationship with those reporting sufficient levels of moderate and vigorous physical activity had lower weight gain (6.6 pounds) compared to those engaged in low amounts of physical activity (13.42

pounds). Limitations mentioned in this study include: restricted sample, self-selection bias, and the use of self-report measures.

Caspersen et al. (2000) examined cross-sectional data from the National Health Interview Survey to determine changes in physical activity patterns in the U.S. by sex and cross-sectional age. Data were analyzed from 54,377 participants aged ≥ 12 years. Physical activity patterns were grouped into 5 categories: 1) leisure-time physical inactivity; 2) regular, sustained, light to moderate physical activity; 3) regular, vigorous physical activity; 4) strengthening activities; and 5) stretching activities. Results during adolescence indicate an increase in physical inactivity from 6% at age 14 to 24% at age 20; reduced regular, sustained activity from 40% to 24% for males, and 30% to 20% for females; reduced vigorous activity from 75% to 42% for males beginning at age 14 and 66% to 28% for females beginning at age 12; strengthening behavior declined for males from 67% to 41% and for females from 48% to 23%; stretching activities declined for both genders from 62% to 33%. Across the adult lifespan 27% of women demonstrated physical inactivity compared to 21% of men. Although now reduced, patterns of sustained and regular, vigorous physical activity seemed to stabilize during the years aged 30 to 64 however strengthening exercises showed dramatic declines during adulthood dropping from 34% to 5% for men and 15% to 1% for women. Patterns of PA saw the greatest reduction during adolescence and young adulthood followed by a period of stabilization. A small increase in physical activity during early retirement was demonstrated followed by another reduction during the final phase of life.

In 1997, Pearman et al. reported on the findings of the impact a required college health and physical education course had on the health status of 979 college students from a potential 1950 alumni from two southeastern United States private liberal arts colleges. The investigators sought to determine if alumni who completed a required health and physical education course differed in health related knowledge, attitudes, and behaviors with alumni from a college without such a requirement and additionally assessed gender differences. The design used was a cross-sectional mail survey. College of graduation and gender served as independent variables while knowledge, attitudes, and behaviors represented dependent variables. A stratified random sample from each college was selected from the graduating classes of 1985, 87, 89, 91, and 93. The response rate was reported at 50% (60% from College-A and 40% from College-B). This statistic introduces some selection bias. The questionnaire used was an adaptation of the Health Habits and History Questionnaire (HHHQ) developed by the National Cancer Institute and consisted of four sections: general health knowledge, attitudes about the influence of the course on exercise, eating, and smoking and alcohol consumption for College-A. For College-B the sections included: the overall college experience, current smoking and physical activity behavior and nutritional practices. Pearson correlation coefficients were reported for the nutrition section only and ranged from 0.73 to 0.94. Results indicated that College-A weighed significantly less and thus had lower BMI scores than College-B (Average College-A weight = 149 pounds, Average College-B weight = 157 pounds). College-A alumni reported a greater percentage of health knowledge for knowing blood pressure (46%), blood cholesterol (36%), and

recommended percentage of dietary fat (52%) compared to College-B with percentages of 35%, 25%, and 37%, respectively. Attitude scores showed more positive impact on College-A behaviors than the overall college experience had on College-B and the most consistently reported positive effect of the course for College-A was the assistance in establishing an exercise program. For self-reported physical activity habits, College-A were more likely to run or jog (moderate-vigorous activity), while College-B were more likely to garden, fish, or hunt (light activity). Nutritionally College-A alumni were more likely to consume fewer calories, more total CHO (with more complex CHO) and less fat than College B alumni. The authors suggested that having two days per week of aerobic exercise and focus on nutrition during the course for College-A produced the significant results in this category and also used this explanation for why 87% of those from College-A reported the course being valuable. The major gender difference reported was men preferred active sports and jogging while women preferred swimming or taking long walks, however women who participated in the health course chose jogging more frequently than College-B alumni suggesting the mastery experience of jogging gained during the health course. Overall, the researchers concluded that the required lifetime health and physical education course completed by College-A had a positive impact on attitudes, behaviors, and health knowledge.

A seven-year longitudinal follow-up to the CARDIA study was conducted by Anderssen et al. (1996) to examine change and secular trends in physical activity patterns in 5,115 young adults aged 18 to 30 years at baseline. Measurement of physical activity was collected via the interviewer-based CARDIA Physical Activity History questionnaire

assessing 8 vigorous and 5 moderate intensity activities. Test-retest reliability was reported ranging from 0.77 – 0.84. Across all sex-race groups results showed a 30% decrease in overall physical activity with a sharper decline noted during young adulthood. Men also reported greater physical activity rates than women.

In 1993 Brynteson and Adams examined the effects of conceptually based physical education programs on attitudes, knowledge, and exercise habits of 1,833 college alumni from four different private Christian colleges after 2 to 11 years post-graduation. A conceptually based physical education program (CPE) differs from an activity based course in that concepts of fitness are taught. College-A required physical education every semester a student was fulltime. After two freshmen level 1-credit concepts of fitness courses were completed, the students then chose six activity courses to participate in. Body composition measured by skinfold procedures and a field test for cardiorespiratory endurance were assessed each semester and results were part of the course grade. In addition outside of class aerobic activity was required each semester, recorded, and part of the course grade as well. College B required a 2-credit hour course in physical fitness concepts and two 1-credit hour elective activity courses. Exercise outside of class was required and assessed by a cardiorespiratory jogging field test in which results impacted the student's grade. College C required a 2-credit hour concepts of physical fitness course and a 2-credit hour personal health course. Students were required to exercise outside of class and perform a field test however the field test did not impact the student's grade and no physical activity courses were required. In College D students could choose a PE activity course from the General Education area of art, music,

speech, or PE. It was determined that 80% of students chose the PE activity course over art, music, or speech. Exercise outside of class or field testing was not required for this PE class. It was mentioned that the procedures to measure attitudes and exercise habits were described in another study by the same authors and no validity or reliability was reported. Results indicated that College A reported that their experience in CPE had a greater relationship to knowledge and attitude towards fitness, and current exercise habits than College's B, C, and D. College D reported less value on exercise and participated in fewer days per week of exercise than College's A, B, C. The authors concluded that required PE programs influence alumni's knowledge, attitude, and participation in exercise. Limitations from this study include a lack of theoretical foundation and testing, no reporting of validity and reliability of measures, data was collected from alumni who graduated between 1974 and 1987 which may limit generalizability to today's college population, and response rate ranged from 32% to 67%. Table 2.1 summarizes the patterns of physical activity behavior among emerging adults.

Table 2.1
Patterns of PA Behavior among Emerging Adults

Author	Sample	Design	Purpose	PA measures	PA patterns	Limitations
Kwan et al. (2012)	N = 640 Age 12-15 at Cycle 1; 24-27 at Cycle 2	Prospective cohort	Patterns of PA based on gender and education	Estimating EE from LTPA via self-report	24% decrease in PA over 12-year period	Health risk behavior by self-report Only changes in LTPA examined
Wengreen & Moncur (2009)	159 college students	Longitud. Observ.	Changes in weight based on PA	Questionnaire -no V/R reported	23% gained \geq 5% of body weight	BMI \geq 25 had > dropout Diet and PA based on self-report recall

Table 2.1 continued...

Mack et al. (2009)	N=127630 College students	Trend survey	Examine freq. and type of self-reported PA from 2000 – 2004	ACHA-NCHA survey 2 items 7 day recall of cardio and strength	57.8% did not engage in at least 3d/w of MPA; 51.4% did not engage in 2d/w of strength training	Self-reported PA Comparison to other schools difficult
Jung et al. (2008)	Female college students N=101	Prospective	Assess stability of diet and PA related to weight changes in 1 st - year college females	GLTEQ: min./wk of mild, mod., vig. PA over past 3 months	-PA assessed at 4 time points: baseline, 8 wks., 25 wks., 52 wks -No change in PA for those who lost weight -Decreased PA for those who gained weight	-Self-report of PA -Inability to track summer PA
Kasperek et al. (2008)	N=193 College freshmen	Cross- sectional	Assess weight changes during 1 st -year college students	3-YRBS questions administered via web	-6 month follow- up -Overweight (>25 BMI) students gained 11 lbs. -Normal weight (<25 BMI) students gained 6 lbs.	-bonus points and cash provide bias -low intensity activity included in activity scores -self reported PA
ACHA-NCHA (2007)	117 campuses N=94,806	Cross- sectional	Assess student health status and behaviors	ACHA-NCHA survey instrument	-44.2% VPA or MPA 3 out of past 7 days -47.7% strength exercises 2 of past 7 days	-self selected schools -self reported behaviors including PA

Table 2.1 continued...

Nelson et al. (2007)	119 campuses N=10,437	Cross-sectional	Prevalence of VPA	Data from 2001 Harvard School of Public Health College Alcohol Study – 1 question assessed VPA for previous 7 days	-70.7% engaged in VPA in HS -47.6% engaged in VPA in college -23.2% engaged in no VPA in college -Females less likely to engage in VPA -HS athletic participation positively associated w/ college VPA	-self reported PA -only assessed VPA -limited to full time college students attending 4-year institutions
McCracken et al. (2007)	18,359 young adults (18-24)	Cross-sectional	Asses health behaviors of young adults	Data from 2003 BRFSS	-43.2% did not meet CDC PA guidelines -39.7% were overweight/ Obese -80.1% of OW/O were trying to lose weight	-self reported behaviors -telephone surveys difficult to reach lower SES and college students
Dinger & Behrens (2006)	N=454 College students	Cross-sectional	Determine PA levels in free-living college students	Actigraph accelerometer	ACSM guidelines: -VPA: 4.6% achieved -MPA: 53% achieved Subjects more active on weekdays	-Sample only full-time college students at one southern university -Mostly white -volunteers may be more active

Table 2.1 continued...

Nelson et al. (2006)	N=2516 Age 11-23	longitudinal	Evaluate 5-yr MVPA trends, computer use	2-questions; adapted GLTEQ	MVPA decline: B: 6.5-5.1 h/wk G: 5.1-3.5 h/wk	Self-report
Gordon-Larson et al. (2004)	N=13,030 Age 18-26	longitudinal	Add Health Trends in achieving 5 sessions of MVPA/wk	PA recall	31% decline in MVPA	Self-report
Bray & Born (2004)	N=145 College students	Retrospect. longitudinal	Examine VPA during 1 st 2 months of college vs. last 2 months of HS	Combined questions from 1995 YRBS & NCHRBS	-VPA decline from 3.32 sessions/wk to 2.68 sessions/wk -66.2% active last 2 months in HS -44.1% active 1 st 2 months in college	Retrospective longitudinal design Self-reported PA Sample were volunteers
Buckworth & Nigg (2004)	N=493 College students	Cross-sectional	Relationship of exercise PA and sedentary behaviors in students enrolled in PA classes	Exercise: NCHRBS PA: CARDIA PAHQ Sedentary Behav.: 3 questions	30 hrs/wk in sed. behav. 30.6% engaged in MPA 53.2% engaged in VPA vs. 37.6%	Self-reported PA Volunteers enrolled in exercise class
Huang et al. (2003)	N=738 College students	Cross-sectional	Assess rate of overweight, obesity, dietary habits, & PA	3 questions from YRBS	27% overweight or obese Aerobic exercise: 2.8 d/wk Strength training: 2.2 d/wk 16.1% reported engaging in no PA	Self-report Volunteers From 1 university

Table 2.1 continued...

Behrens & Dinger (2003)	N=31 College students	Descriptive	Examine ambulatory PA patterns	Yamax Digiwalker Pedometer	Averaged: 9,932 steps/d More active on weekdays	Small sample Inability to track intensity, type of PA
Sparling & Snow (2001)	N=367 College alumni	Cross-sectional	Characterize patterns of PA in recent college alumni	3 questions from NCHRBS	Mean time since grad.: 6.2 years -32.7% engaging in VPA -6% engaging in MPA -21% engaging in strength training -84.7% active in college; active now -81.3% not active in college not active now	Self-report Alumni from one institution Self-selection bias
Caspersen et al. (2000)	N=54,377 Aged ≥ 12	Cross-sectional	Changes in PA patterns by sex and cross-sectional age	National Health Interview Survey	Greatest reduction in PA: adolescence, young adult	Self-report Leisure-time PA only measured
Pearman et al. (1997)	N=979 College alumni	Cross-sectional	Impact of required H & PE course on knowledge, attitude, behavior	Health Habits and History Questionnaire	College A (required H & PE course): -greater % knowledge of BP, Chol., & % fat intake	Response rate > for college A indicating bias Overall response rate Only 2 private schools

Table 2.1 continued...

Anderssen et al. (1996)	N=5115 Aged 18-30	Longitud. Observ.	PA patterns in young adults	Interviewer-based CARDIA physical activity history	30% decrease in total PA Sharper decline in early adulthood	Self-report
Brynteson & Adams (1993)	N=1833 4 diff. colleges	Cross-sectional (data from 1974-1987)	Effects of 4-levels of PE on attitudes, knowledge, exercise	Self-report measure	College A: greater relationship to knowledge and attitude towards fitness and current exercise habits The > the PA requirement, the more positive the relationship More frequency of PA in alumni that took required CPE course	Self-report Selection bias Data collected on graduates from 1974-1987 – may not apply to today's student

Synthesis of Patterns of Physical Activity Behavior

This review regarding patterns of physical activity among the emerging adult has revealed a consistent reduction in physical activity rates among this population that continues until adulthood where lowered levels of physical activity then begin to stabilize. The greatest reduction in physical activity across the lifespan occurs during adolescence and young adulthood (Caspersen et al., 2000). While the data presented here are primarily cross-sectional and descriptive in nature not allowing for the inference of

causality, the supporting evidence permits the ability to establish associations. Fourteen of the twenty studies reviewed involve college students as the target population which sought to establish patterns of physical activity behavior, dietary changes, weight status, or other health behaviors of college students. Collectively the college studies demonstrated a reduction in physical activity from high school through the college years. Evaluation of data from the ACHA-NCHA survey (2000-2004) conducted by Mack et al. (2009) reported that 57.8% of college students were not engaging in at least 3 days/week of moderate physical activity and over 50% of those that are active are motivated by the desire to lose weight. Body mass index results suggest that a majority of college students' border on the overweight category and those in this group gain twice as much weight their first semester of college than those in normal weight categories (Kasperek et al., 2008). Dinger and Behrens (2006) reported 47% of college students not achieving ACSM guidelines for moderate physical activity. Multiple studies reported on weight gain and physical activity among college students and reported that for those who gained weight during college, physical activity decreased (Wengreen & Moncur, 2009; Jung et al., 2008; Kasperek et al., 2008; Huang et al., 2003; Sparling & Snow, 2001). Results regarding physical activity patterns demonstrate a reduction in vigorous physical activity in the transition from high school to college as well (Nelson et al., 2007 and Bray & Born, 2004), while once enrolled other researchers (Jung et al., 2008; Kasperek et al., 2008) demonstrated that physical activity levels remained stable from baseline up to one year follow-up. Gender differences also emerged with males participating in more physical activity than females (Nelson et al., 2007, 2006). In the alumni follow-up

studies (Sparling & Snow, 2001, Pearman et al., 1997, and Brynteson & Adams, 1993), the results of participation in a physical activity course in college had a positive impact on knowledge, attitude, and participation in exercise post college graduation. In a meta-analysis of college students' physical activity behaviors results indicated that college students were more active on weekdays, participated in activities they are already comfortable with, do not consider walking a popular or beneficial form of physical activity with additional data showing college student physical inactivity rates ranging from 36% to 50% (Keating et al., 2005).

While data regarding physical activity patterns among college students are more readily available, less is understood about the emerging adult outside of higher education. Four studies not specifically identifying college students as the target population but rather young adults demonstrate a trending toward a reduction in physical activity rate during emerging adulthood that ranged from 24% to 31% (Kwan et al., 2012; Nelson et al., 2006; Gordon-Larson et al., 2004; and Anderssen et al., 1996). It is unclear what the current rate of physical activity behavior is for this understudied population.

The greatest limitation in the majority of the studies is the consistency with which self-report measures are employed to establish physical activity rates. Although many studies reported or referenced validity and reliability of the measure, the subjective nature of self-report introduces bias as subjects may offer socially desirable answers and may have the tendency to overinflate their rates of physical activity. Dinger and Behrens (2006) did utilize an accelerometer to determine free-living physical activity levels in college students and in 2003 used a pedometer to track physical activity behavior among

college students however the sample size may be considered too small at 31 to detect significant changes. Clearly the tracking of physical activity behavior through more objective measures is warranted given realistic opportunities.

Recommendations by the authors reviewed for further research regarding physical activity behavior among the emerging adult exhibited a common pattern. It is suggested that future studies should emphasize the prevention, maintenance, or increase of physical activity during the transition to adulthood with the combination of educational and behavior modification programs staggered throughout this period of life transition. Additional suggestions recommend further emphasis on weight gain prevention; targeting of high risk groups (overweight/obese emerging adults or those classified as sedentary); and include initiatives for the emerging adult to engage in more physical activity on the weekends. What is lacking seems to be an emphasis on the emerging adult outside of traditional higher education.

Determinants of Physical Activity Among Emerging Adults

For the determinants review of literature, the keywords physical activity, college students, young adults, emerging adults, correlates, mediators, and determinants were explored using a computerized database search and produced the following results: PsychInfo (13 matches), MEDLINE (11 matches), PubMed (11 matches), and an advanced multi-database search (79 matches). Additionally an investigation of the reference list of relevant articles was conducted. Much of the determinants research regarding physical activity behavior in college students has emphasized the use of Bandura's Social Cognitive Theory that posits a reciprocal relationship among behavioral

factors primarily focused on cognitive processes, personal factors, and environmental influence. Determinants research specifically targeting the emerging adult and physical activity behavior was unsupported therefore the focus of this review of literature emphasizes the social cognitive and personal influences on physical activity behavior among college students which produced 18 individual studies included for this review.

A qualitative analysis of psychosocial and environmental determinants of eating behaviors, physical activity and weight change among college students was conducted by LaCaille et al. (2011) utilizing six focus groups among 49 undergraduate college students at a medium-sized Midwestern university. For the purposes of this review, results regarding the determinants of physical activity will be reported. Results indicated that the psychosocial determinants for physical activity among this group were the positive feelings associated with being in shape, relaxation, improved mood and memory, and social support from friends to stay motivated for physical activity. The transition to college life and lack of time served as primary psychosocial barriers to being physically active. Students suggested scheduling physical activity as part of their regular schedule to maintain the behavior in the presence of competing demands. Students regarded having adequate options for physical activity within the college environment as facilitating their behavior. Women were more likely to express some perceived environmental barriers that included the extra cost of fitness classes, crowds, being uncomfortable exercising in front of others especially males, and not knowing how to use the equipment. The authors suggest future research/interventions focus on the gender

differences presented along with enhancing social support, integrating self-regulation skills during the first year, and providing a variety of exercise options on campus.

In an effort to better understand Bandura's three types of outcome expectations; physical, social, and evaluative and their ability to mediate self-efficacy and affect behavior, Taber et al. (2010) sought specifically to determine the different types of expectations that college students have regarding exercise and whether each type of expectation mediates the relationship between self-efficacy and exercise. The sample consisted of 290 college students who completed a 51-item questionnaire consisting of exercise rate, expectations, self-efficacy, social influences, physical traits, and demographics. Validity and reliability for the components of the questionnaire were reported and considered by the authors acceptable. Factor analysis revealed four expectation factors: physical, mental, social, and self-evaluative. Cronbach's alpha demonstrated reliability ranging from 0.72 to 0.87. Mediation analysis revealed a significant positive association between expectations and self-efficacy however only social expectations was significantly associated with exercise score. Self-evaluative expectations were not significantly associated with either exercise score or self-efficacy while self-efficacy was significant with respect to exercise score. When expectation factor and self-efficacy were included together in the regression model, only self-efficacy remained significantly associated with exercise score. The authors concluded that when controlling for self-efficacy, expectations have no independent association with exercise and that self-efficacy remains the primary social cognitive determinant of exercise among college students. Additionally by individualizing expectations the authors were able to

recognize a significant association with social expectations and exercise when unadjusted for self-efficacy and suggest future interventions focus on promoting the friend-social benefits of exercise as a means to increase behavior. The authors also concluded that education about the mental and physical benefits of exercise are redundant as college students are well aware of those benefits but continued efforts on increasing self-efficacy to cope with barriers and strategies for time management and prioritization of exercise behavior are paramount.

Doerksen et al. (2009) attempted to expand upon the work of Petosa et al. (2003) and examine the relationship of self-efficacy, outcome expectations, and physical activity goals on moderate and vigorous physical activity over an entire semester using an objective measure in a sample of 69 college students. The Social Cognitive Theory (SCT) constructs of exercise self-efficacy and outcome expectations were measured using valid and reliable questionnaires. Physical activity (PA) goals for the semester were assessed by asking subjects to list their primary goal based on 5-point scale (*1=not exercise to 5=exercise 7 days a week for 30 or more minutes per day*). An ActiGraph accelerometer was used to objectively measure physical activity using Freedson's cut points (MPA=1952-5725 counts/min; VPA \geq 5725 counts/min). This device was applied three months after the initial meeting and worn for seven consecutive days. Results indicate that all SCT constructs were correlated with each other however only physical activity goals at baseline was positively associated with moderate PA at follow-up. For vigorous PA having stronger self-efficacy and higher PA goals at baseline were significant. Regression analysis revealed that 16% of the variance in vigorous PA was

explained. For moderate physical activity, BMI emerged as the only significant predictor whereas for vigorous PA, having physical activity goals and higher self-efficacy were significant predictors explaining 16% of the variance PA. In this study outcome expectations were not a significant predictor for moderate or vigorous physical activity.

In an effort to identify lifestyle factors related to weight gain in college students Strong et al. (2008) investigated health-related lifestyle behaviors (nutrition and physical activity) and the psychosocial correlates of social support, self-regulation, outcome expectancies, and self-efficacy in 43 first- and second-year college students enrolled in non-health related majors. Measurements included the Health Beliefs Survey for SCT determinants of eating behaviors; the Three-Factor Eating Questionnaire; assessment of physical activity theory-based determinants; an interview assessing the prioritization of activities among college students; and physiologic measures (body weight, composition, waist circumferences, resting BP, cardiorespiratory endurance). Results reported here will focus only on the psychosocial correlates related to physical activity behavior. The SCT constructs were correlated with time spent in moderate-vigorous physical activity demonstrating correlation coefficients of 0.45 for self-regulation for exercise plans; 0.49 for self-efficacy; and 0.33 for outcome expectations. Cardiorespiratory endurance correlated with self-efficacy ($r=0.52$) and self-regulation for exercise goals ($r=.54$). The authors suggest that weight gain prevention interventions should involve skill exercises that promote self-monitoring, planning, goal setting, self-efficacy, and positive outcome expectations while furthering the development of environmental and social support.

In a study by Shen and Xu (2008) the influence of self-efficacy, body mass and cardiorespiratory fitness level on leisure-time motives of 208 Chinese college students was assessed. The authors were interested in determining to what extent exercise motive differs by gender, and to what extent did self-efficacy, body mass, and cardiorespiratory fitness level influence those motives. Exercise motive was assessed using the 51-item Exercise Motivations Inventory version 2 (EMI-2) with internal reliability ranging from 0.69 to 0.95. Self-efficacy was measured using a 14-item Perceived Self-Efficacy Scale with a reference provided for the reliability of the scale. Body mass index (BMI) was used to assess body mass by taking weight in kilograms and dividing that by height in meters squared. Construct validity was mentioned as being well demonstrated in other studies. To assess cardiorespiratory fitness scores from the long-distance run test were obtained. Results from the questionnaires indicated that men had higher exercise motivation for interpersonal reasons, while women were more motivated by body-related reasons. Correlation analysis revealed a positive correlation between cardiorespiratory fitness (CF) and self-efficacy for both genders meaning as CF increased self-efficacy also increased. Regression analysis for men revealed that CF predicted psychological motives and accounted for 16% of the variance. For women, self-efficacy predicted 22% of the variance. For interpersonal motives for men CF and self-efficacy comprised 20% of the variance, and for women self-efficacy accounted for 18% of the variance. BMI did not predict interpersonal motives for either gender. For body-related motives BMI accounted for 18% and 15% of the variance for men and women, respectively. There were no significant predictors for health and fitness motives for either gender. According to the

authors of this study the results suggest that women are motivated more by body-related concerns and men by interpersonal motives. In addition the regression analysis revealed that both psychological and physical variables influence exercise motivation. Body-mass-index also had an effect in that exercise motives were positively predicted by BMI suggesting that college students' body dissatisfaction could influence exercise habits and provide motivation for continued exercise behavior, although extrinsic in nature.

Another interesting finding noted by the authors is that college students' in this study were not motivated for health and fitness reasons.

A study examining the effects of self-efficacy on physical activity by Hu et al. (2007) focused on the influence of a self-efficacy manipulation on physical activity enjoyment among 28 low to moderately active college-aged women. A self-efficacy scale developed by Rudolph and McAuley (1996) for assessing one's belief to cycle over durations of moderate to hard intensity without stopping was used and produced an internal consistency in this study of 0.95. Enjoyment of physical activity was assessed using the PACES instrument which produced an internal consistency of 0.92. Procedures for this study involved the random assignment of subjects to either a low-efficacy (n=14) or high-efficacy group (n=14). In the first visit subjects completed the self-efficacy questionnaire; performed the exercise test; reviewed their false feedback (self-efficacy manipulation); then completed the self-efficacy questionnaire again along with the enjoyment measure. A second bout of more intense exercise was performed 2-3 days later to determine whether the manipulation effects at higher intensities would generalize to more moderate activity levels. False feedback was again provided; the efficacy scale

completed; followed by a 30 minute bout of more intense exercise (60% VO₂); and again the self-efficacy scale and PACES were completed. For both exercise bouts a 2 X 2 mixed model ANOVA was used to analyze the effect of the manipulation on self-efficacy. To assess differences in enjoyment scores an independent samples t-test was conducted. The results from this study indicate that those participants in the high-efficacy condition demonstrated more enjoyment of physical activity following the maximal exercise test. For moderate exercise the efficacy-enjoyment relationship demonstrated weaker results and was not significant.

In a study of 127 first-year college students Bray, S.R. (2007) examined students' self-efficacy for coping with barriers to both moderate and vigorous physical activity and investigated levels of physical activity from pre-transition to the first year at university. Pre-transition physical activity (8 months prior to starting college, January to August) and post-transition (September to March) was measured via self-report using the validated MAQ-A (Modifiable Activity Questionnaire for Adolescents). Self-efficacy for coping with barriers to physical activity was assessed using a 12-item self-report instrument developed for this study based on previous work by Gyurcsik et al. (2004). Participants completed the questionnaires during the first and second weeks of the fall semester and again during the last week of the spring semester in March. Results demonstrated that self-efficacy for coping with barriers to physical activity explained 18% of the variance in physical activity. Principal components analysis revealed two different self-efficacy components; termed by the author as personal-social and environmental. The personal-social barriers demonstrated a greater influence on physical activity behavior which may

suggest that environmental factors are of limited importance among college students.

The author suggests future studies investigate the extent to which vicarious experience, verbal persuasion and mastery experience can influence self-efficacy to overcome barriers to physical activity.

In 2005 Kilpatrick et al. sought to compare sport participation and exercise motivation among 233 students (mean age of 22.2) enrolled in undergraduate health and kinesiology courses (7 courses sampled) at a southeastern United States university. Data were collected voluntarily during one class meeting of each course. Self-report of physical activity demographics were assessed using four single-item indicators measuring adherence, frequency, intensity, and duration. Physical activity motivation was measured using two versions (word substitutions for exercise and sport) of the EMI-2 questionnaire which is composed of 51 items with 14 subscales reflecting different motivations for physical activity. Alpha coefficients for sport ranged from 0.69-0.95 and for exercise from 0.67-0.95. Descriptive data of physical activity participation indicated the subjects participated more in exercise ($M = 3.58$ d/wk) than sport ($M = 2.14$ d/wk); intensities were greater for exercise ($M = 6.35$) than sport ($M = 5.72$); whereas ratings for duration and adherence were similar (exercise duration $M = 3.90$, sport duration $M = 3.88$; exercise adherence $M = 3.70$, sport adherence $M = 3.70$). Results from the ANOVA indicated greater motivation to exercise for appearance, strength/endurance, stress management, weight management, health pressure, ill-health avoidance and positive health with the largest effect sizes for ill-health avoidance, appearance and positive health (-0.91 , -0.91 , -0.90). Greater motivation for sport was influenced by affiliation,

challenge, competition, enjoyment, and social recognition with the largest effect sizes for affiliation and competition (1.19, 0.74). Significant gender effects emerged for motivation with women rating weight management higher and men rating challenge, competition, social recognition, and strength/endurance higher with the largest effect size for competition (0.89). Interactions also occurred for activity type and varied with gender. Men rated enjoyment as a motive for sport while women's ratings were similar across exercise and sport. For stress management motivation for sport was indicated for men whereas motivation for exercise aligned with women. For positive health exercise was more associated in both genders. For weight management both genders considered it more important for exercise. Overall the authors concluded that college students' motivation for sport is more intrinsic while motivation for exercise is linked to more extrinsic outcomes.

In an attempt to study health behaviors in college students, Von Ah et al. (2004) sought to examine the effects that perceived availability of and satisfaction with social support, perceived stress and self-efficacy would have on multiple behaviors; including physical activity/nutritional behavior of 161 undergraduate college students, and explore the roles of perceived threat, benefits, and barriers on these health behaviors. The participants were assessed one time during mid-semester using multiple self-report instruments all of which reported adequate reliability and validity. Results indicated that perceived stress levels were moderate and satisfaction with social support was very high along with self-efficacy. Approximately 45% of the sample reported exercising for 20 minutes more frequently to every day for the past 3 months. Further results indicated that

self-efficacy was the only significant predictor across all five health behaviors (alcohol, smoking, PA/nutrition, general safety, sun-protection). This study also reported that perceived stress and social support did not significantly influence the five behaviors, which is in contrast to other research findings. In exploring predictors of physical activity and nutritional protective behavior structural equation modeling revealed under high perceived threat that perceived barriers served as a moderator with the direct path from self-efficacy remaining significant. In other words, the lower the perceived barriers and the higher the self-efficacy the more likely the participants practiced good nutrition and engaged in exercise regularly. In summary the authors concluded that self-efficacy remains a significant construct in reducing perceived barriers of health behaviors among college students and that social support lacked significance.

To investigate barriers to vigorous physical activity (PA) and examine coping and task self-efficacy as predictors of vigorous PA, Gyurcsik et al. (2004) conducted a study on 93 female freshmen university students with a mean age of 17.84 years and mean BMI of 22.28 kg/m². To assess barriers to vigorous PA over 4 weeks, a semi-structured, open-ended questionnaire was used in which participants listed up to 5 barriers to vigorous PA (no information regarding validity or reliability was reported). Coping self-efficacy was determined by the subject responding to how confident they were to coping with each barrier listed in the previous questionnaire. The intraclass correlation reported was 0.70. A 3-item measure assessed task self-efficacy by indicating the subject's confidence in their ability to perform 20 minutes of vigorous PA one, two, and three days/wk over 4 weeks. Internal consistency was reported at 0.92. Vigorous PA was measured using a

modified version of Godin's Leisure Time Activity Questionnaire by asking participants to assess vigorous PA during a "typical week" during the past month. The procedures involved students completing a 10-minute questionnaire assessing demographics and barriers, coping self-efficacy and task-self efficacy for the next four weeks. At the end of the four weeks, a 5-minute questionnaire was administered to assess vigorous PA. The open-ended interviews produced 441 barriers condensed into 53 specific barriers with the average number of barriers listed per participant as 3.51. These barriers were then classified as either: intrapersonal, interpersonal, institutional, community, public policy, physical environment, or unclassifiable. Results indicate that the barriers cited ranked in the following order: institutional (33%), intrapersonal (26%), interpersonal (25%), physical environment (11%), community (5%), and public policy (0%). The most salient barrier in each category is reported respectively as follows: school workload too high, lack of motivation, social invitations/obligations, weather conditions, and lack of transportation. For coping self-efficacy subjects reported moderate confidence ($M = 6.24$) and somewhat higher ($M = 7.92$) for task self-efficacy. The mean for vigorous PA participation over the 4 weeks was 2.82 d/wk. Overall, 47% of the sample did not meet the recommended amount of 3 vigorous PA bouts per week. From the regression model coping self-efficacy predicted task self-efficacy and task self-efficacy predicted vigorous PA. The authors indicated that to enhance interventions targeted towards transitioning students to university, identifying the salient barriers is critical and within this study each participant averaged 3.51 barriers to vigorous PA suggesting multiple obstacles. A relationship existed in this study between school workload and external work (job outside

of school) that may significantly influence the perceived or actual free time a transitioning college student may have for vigorous PA.

In 2003 Leenders et al. examined the demographic characteristics of students from a large public Midwestern university enrolled in physical activity courses, their primary reasons for enrollment and the health behavior characteristics of those students. A survey was administered to 2155 students enrolled in 41 physical activity courses during the first week of class during winter quarter 1999. The three parts of the questionnaire were: primary reasons for enrolling in the course, demographic characteristics and health behaviors. Results indicated the main reasons for enrolling in activity courses for both men and women were to: learn a new skill (20%), have fun (18%), improve skills (11%), improve fitness (9%), and exercise regularly (9%) which accounts for 67%. Additionally 69% of the sample indicated exercising outside of their activity course. Female students were more likely to feel overwhelmed, depressed, eat more fruits and vegetables, less likely to consume alcohol, spend more time studying and less time watching television/videos or using the computer than men. The authors suggested that further curricula in physical activity courses be cognizant of students desire to 'have fun' and 'learn a new skill' as important considerations and develop further methods to encourage participation of physical activity outside of class.

In an effort to predict vigorous physical activity using Social Cognitive Theory (SCT), Petosa et al. (2003) sampled 350 college student volunteers from a Midwestern university who over three class sessions completed questionnaires measuring SCT constructs which included self-regulation, outcome expectancy, exercise-role-identity,

positive-exercise-experience, and social support. During the four weeks following participants completed a 7-day recall of PA questionnaire. All measures were reported as valid and reliable. Results from the study indicate that over the four weeks, 45% of the sample averaged less than 1 d/wk of vigorous physical activity (VPA) and 34% averaged less than 3 d/wk of VPA. This indicates that approximately 79% of the subjects were not achieving at least three or more bouts of VPA a week. Overall the average scores on the SCT constructs were low and correspond with the low levels of vigorous PA.

Hierarchical multiple regression analysis was used to determine the ability of SCT to predict vigorous PA with the dependent variable being total days of vigorous PA over the four weeks and the SCT constructs serving as the independent variables. All SCT constructs were significant in the model and explained 27.2% of the variance. The authors indicated that the low rates of vigorous PA reported are not consistent with other studies and suggest that tracking physical activity over a four week period may give a more realistic estimate of physical activity behavior rather than offering a single point estimate of physical activity. In addition the SCT constructs under study explained 27.2% of the variance in vigorous PA and therefore supports its usefulness in studying physical activity behavior in college students.

Rovniak et al. (2002) used a prospective structural equation analysis to test Bandura's Social Cognitive Theory (SCT) model of physical activity among young adults and develop measures of exercise self-regulatory skills to explore the relationship between physical activity and exercise self-regulation. A questionnaire that included social support, self-efficacy, self-regulation, outcome expectations, and physical activity

measures of the SCT model was administered to 353 undergraduate students. Validity and reliability scores were reported. A total of 229 students returned one week later for test-retest reliability and 283 students returned at 8-weeks post for assessment. Structural equation modeling was used to assess the fit of the SCT model to the data. For the fit of measurement, maximum likelihood estimation was used. The results showed that the sample had similar BMIs and levels of physical activity compared to other college students. Social support indicated a moderate effect on physical activity mediated by self-efficacy (0.28) and overall self-efficacy had the greatest total effect on physical activity (0.71). Outcome expectations had no significant effect (0.21), while self-regulation indicated a strong total effect on physical activity (0.48). This model explained 55% of the variance in physical activity with self-regulation presenting as a strong mediator of self-efficacy. The researchers concluded that self-regulation should be included in interventions with emphasizing the ability to have mastery experiences.

Wallace et al. (2000) sought to determine the number of students in each of the five exercise stages supported by the Stage of Change Theory and to test the efficacy of Social Cognitive Theory in predicting stage of change for exercise. A cross-sectional survey was mailed to a simple random sample of 3,388 undergraduate students with 937 questionnaires used for analysis producing a response rate of 28%. The 78-item questionnaire was field tested for suitability and pilot tested for 1-week test-retest reliability. Validity and reliability scores were reported. Results indicated that 52.3% were minimally or irregularly active representing pre-contemplation, contemplation, and preparation stages. Those in the maintenance stage were 31.1%. Significantly more

males were in the maintenance stage than females. Physical activity history, exercise self-efficacy and non-exercise VO₂max loaded significantly on the first function. For the second function participation in physical education classes was most significant. Gender revealed being a significant predictor of stage of exercise behavior therefore separate analyses were performed by gender. Family social support (0.27) and exercise self-efficacy (0.45) were most important for females, while friend social support (0.36), physical activity history (0.34) and exercise self-efficacy (0.29) emerged as significant for males. Group centroids revealed that for social cognitive variables the greatest difference was seen between recent adopters (action) and those already exercising for more than six months (maintenance). The authors surmised from this study that exercise self-efficacy was the most significant predictor of stage of exercise behavior change with social support (family for females and friend for males) also emerging as an important predictor of physical activity for college students.

Sullum et al. (2000) conducted a prospective study examining factors that might predict exercise maintenance and relapse in a population of 52 physically active college students. Measures included: the Processes of Change Questionnaire consisting of 40 items determining which processes are used at various stages of change (internal consistency 0.62-0.89), a decisional balance questionnaire containing 16 statements regarding pros and cons for exercise (internal consistency 0.70 and 0.56, respectively), and a self-efficacy measure rating participants' exercise confidence in certain situations (internal consistency 0.82). Exercise relapse was defined as those who went from exercising 3 times per week for 20 minutes to not meeting this criterion at 2-month

follow-up. Results indicated that 13% of the participants relapsed and for process of change no significant differences between maintainers and those that relapsed were found in their baseline scores. Decisional balance analysis revealed that those who relapsed scored significantly higher on the con scale at baseline than maintainers, but no differences were evident on the pro scale. For self-efficacy those that relapsed scored lower at baseline. Results from this study indicate that decisional balance and self-efficacy were predictive of exercise relapse while processes of change were not. The authors suggest that interventions should initially focus on reducing the cons of exercise and then transition to emphasize the pros and building of self-efficacy. The use of the Transtheoretical Model of Behavior Change for college students' exercise practices is supported according to the researchers through the demonstrated effect of self-efficacy, decisional balance and although processes of change were not statistically significantly predictors of relapse an explanation of small sample size was given for this finding.

In a study by Frederick et al. (1996) the authors examined how affect mediates exercise habits in men and women with motivational orientation toward exercise as a direct predictor of affective attitude toward exercise. Included in the study were 118 subjects (38 men, 80 women) with a mean age of 22 enrolled in psychology classes. The Motivation for Physical Activity Measure-Revised was used and is described as a 32-item self-report measure assessing motives for participation in exercise, sport, or physical activity. Reliability was reported from 0.69 to 0.90 based on previous work and high construct validity was mentioned. The Exercise Enjoyment Questionnaire was implemented to assess enjoyment and commitment to exercise based on a 20-item self-

report questionnaire. Previous work reported test-retest reliability as 0.68. A four-item attitude and adherence questionnaire was also used with no information provided regarding reliability or validity of this measure. The questionnaires were administered in a group setting with a trained researcher present to answer questions. A two-stage path analysis was conducted where affect was hypothesized to predict outcome and motivational orientation was hypothesized to predict affect but not outcome. For the men body-related motivation predicted days per week of exercise; exercise fulfillment predicted hours per week of exercise; and interest/enjoyment predicted perceived competence. For women in this study motivation for skill development and exercise fulfillment predicted perceived competence; motivation for skill development predicted exercise fulfillment; and interest/enjoyment motivation predicted satisfaction. The authors commented that for men intrinsic and extrinsic motivation may influence exercise adherence, whereas women may be driven more by intrinsic motivation.

Yordy and Lent (1993) examined the effectiveness of the Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), and Social Cognitive Theory (SCT) in predicting aerobic exercise intentions and behavior among 284 college students. Subjects completed validated and reliable questionnaires relating to TRA, TPB, and SCT at two group-testing times held one week apart. Aerobic exercise behavior was assessed at the end of one week with a dichotomous self-report of either “yes” or “no”. Constructs specifically targeted included attitude, subjective norm, perceived control, self-efficacy, outcome expectations, intentions, and prior exercise. Results indicated that across theoretical models, those subjects with greater efficacy and outcome expectations

displayed a more positive attitude towards exercise along with subjective norm. Specifically in the TPB attitude predicted intention to exercise ($R^2=.58$) along with subjective norm ($R^2=.01$). For SCT variance explained for self-efficacy, outcome expectations and their interaction were $R^2 = .34, .11, \text{ and } .01$, respectively. Overall the variance explained in aerobic exercise behavior for the theoretical predictors was 36% which included intentions, self-efficacy, and outcome expectations.

Dzewaltowski et al. (1990) compared Social Cognitive Theory (SCT), Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) for their ability to predict physical activity participation. A 7-day recall questionnaire for physical activity was completed by 254 college students each of four consecutive weeks. It was indicated that validity and reliability for the questionnaire has been established. Results indicated that the student's physical activity behavior was not consistent over time with inter-correlations ranging from .50 to .76. The constructs measured via questionnaire for the TRA and TPB included: intention ($r=.96$), attitude toward physical activity participation ($r=.83$) and perceived behavioral control ($r=.87$). The constructs measured for SCT included: self-efficacy ($r=.97$), outcome expectations ($r=.92$) and self-evaluation of behavior and outcomes (self-regulation). Descriptive data for the TRA/TPB indicated that the students had positive attitudes towards engaging in physical activity over the following four weeks, cognized the behavior as attainable and had good intentions for involvement. Subjective norm did not influence attitude's prediction of intention as TRA hypothesizes. For the TPB perceived behavioral control was significant in affecting intentions. In essence the better attitude and cognized control over the behavior the

greater the intention. Results indicated that intention did predict physical activity engagement ($F=27.64, p<.001$). Descriptive data for SCT indicated that students were moderately confident in performing physical activity and achieving worthwhile outcomes. Multiple regression analysis revealed that self-efficacy and self-evaluation of behavior were significant in predicting physical activity ($F=16.38, p<.001$). When controlling for past physical activity behavior though only self-efficacy contributed significantly suggesting that satisfaction with current exercise behavior is not an indicator of potential behavior but rather a result of previous behavior. Table 2.2 summarizes the determinants of physical activity behavior among emerging adults.

Table 2.2
Determinants of PA Behavior among Emerging Adults

Author	Sample	Design	Purpose	Measures	Determinants	Effect
LaCaille et al. (2011)	N=49	Qual.	Identify determinants of PA	Focus group tape recordings and transcription	Motivation Social support PA convenience	Friend SS Motivation to be in shape Adequate exercise opportunity
Taber et al. (2010)	N=290	Cross-sectional	Identify types of expect. and their relation with SE	51-item questionnaire GLTEQ	Expectations: SE Social influ.	Physical, mental, social, self-evaluative -SE sig. -social factor sig. with exercise score
Doerksen et al. (2009)	N=69	Prospec.	Determine if core SCT constructs predict M & V PA at end of semester	ActiGraph acc.	SE OE PA goals	Vig PA = .16
Strong et al. (2008)	N=43	Prospec.	Identify targets to improve health behaviors	7-day activity logs, verified by 7-day pedometer	SR, SS, SE, OE	SCT constructs correlated with time spent in MVPA

Table 2.2 Continued

Shen & Xu (2008)	N=208	Cross-sectional	Influence of SE, body mass, CRF on leisure-time motives	EMI-2 Perceived SE scale BMI CR: long distance run test	SE Body mass Cardio. resp. fit.	M: interperson. reasons P _{psych} C=16% IP:CF,SE= 20% -BR: BMI = 18% W: body-related reasons -P _{psych} : SE = 22% IP: SE = 18% BR: BMI = 14%
Hu et al. (2007)	N=28	Quasi.	Examined SE on enjoyment of PA	PACES enjoyment scale	SE	Those in high SE condition reported > enjoyment of VPA
Bray, S.R. (2007)	N=127	Cross-sectional	Examine SE for coping with barriers to PA	MAQ-A 12-item SE questionnaire	SE	18% variance explained
Kilpatrick et al. (2005)	N=233	Cross-sectional	Compare sport & exercise motiv.	EMI-2	Motivation	Exercise: ill-health avoidance, positive health, appearance Sport: affiliation, competition
Von Ah et al. (2004)	N=161	Cross-sectional	Examine perceived stress, SS, & SE on PA behavior	PSS (perceived stress scale) SSQ6 41-item SE scale 46-item HB scale	PS SS SE	SE emerged as significant predictor
Gyuresik et al. (2004)	N=132	Cross-sectional	Examine barriers to VPA	Questionnaires for: barriers, coping SE, task SE VPA: GLTAQ	Ecological approach -intrapersonal -interpersonal -institutional -community -PA environmental	Coping SE predicted Task SE Task SE predicted VPA Participants averaged 4 barriers to VPA
Leenders et al. (2003)	N=215 5	Cross-sectional	Primary reason for enrolling in PA courses	Questionnaire developed for this study	N/A	Enrollment: - new skill: 20% -have fun: 18% -improve skills: 11% -improve fitness: 9% -exercise regularly: 9%
Petosa et al. (2003)	N=350	Prospect.	Test SCT constructs to predict VPA	7-day recall (self-report)	SR, OEV, exercise role, ident., pos. ex. exp., SS, SE	Vig PA = .27

Table 2.2 Continued...

Rovniak et al. (2002)	N=277	Prospect.	Test SCT constructs to predict PA	SOC for exercise behavior (self-report)	SS, SE, OE, SR	MVPA: .55 (SE & SR contributing most)
Sullum et al. (2000)	N=52	Prospect.	Examine factors predicting maintenance and relapse	Combination of previously validated questionnaires	POC DB SE Exercise relapse	POC: no diff in relapsers or maintainers DB: no diff. SE: relapsers scored lower ER: pros for exercise decreased over time in relapsers
Wallace et al. (2000)	N=937	Cross-sectional	Examine characteristics associated w/ different stages of exercise behavior	SOC for exer. CARDIA (self-report)	SE, SS	SE: most sig. predictor of SOC
Frederick et al. (1996)	N=118	Cross-sectional	Examine how affect mediates exercise habits	Motivation for PA measure-revised EEQ	Motivation	M: body-related motivation W: skill development, exercise fulfillment
Yordy & Lent (1993)	N=284	Predictive	Examine utility of TRA, TPB, & SCT	Self-report of aerobic exercise	TRA: attitude, sub. norm TPB: PBC SCT: SE, OE	Intention to exercise -TBP/TRA = .23 -SCT = .15
Dzewaltowski et al. (1990)	N=254	Predictive	Compare TRA, TBP, & SCT to predict PA participation	7-day recall (self-report)	TRA/TPB: intention, attitude, PBC SCT: SE, OE	Intention = .10 SE = .07

Synthesis of Determinants of Physical Activity Among Emerging Adults

In 2003 Nahas et al. reviewed the literature on determinants of physical activity in adolescents and young adults to establish the basis for high school and college physical education programs to promote active lifestyles. Their review identified common theoretical models which served as the foundation to explain physical activity behavior

and included: the Health Belief Model, Social Cognitive Theory, Stages of Change and Ecological Models. The classification of determinants was often categorized into personal characteristics, psychosocial determinants, environmental determinants and physical activity characteristics. Further analysis identified self-efficacy as being highly correlated with physical activity along with intention. Perceived barriers included lack of time (competing demands), lack of money, minimal access to facilities, lack of social support and lack of enjoyment. In the meta-analysis of college students' physical activity behaviors Keating et al. (2005) also identified four categories of determinants which included: personal, social, cognitive, and environmental factors. Personal factors influencing physical activity behavior found that rates of physical activity declined with age; men tended to participate in more weight lifting and team sports; and women preferred aerobic activities. Social support from family was found more important for women while social support from peers was most significant for men. Self-efficacy, perceived enjoyment and self-motivation emerged as significant cognitive predictors of physical activity behavior.

This review of the literature on determinants of physical activity behavior among college students and young adults represents a mix of cross-sectional and prospective designs. The studies analyzed for this literature review were dated from 1990 to 2012. Sample sizes ranged from 52 to 2155. In the majority of studies validated questionnaires were utilized to assess the determinants. Motivation for physical activity or exercise was specifically assessed in five studies and found that college students are primarily motivated by body-related concerns and seem unconcerned about long-term

consequences of inactivity. Reasons for enrolling in physical activity courses suggest that college students do so for skill development, enjoyment, or to learn a new skill; not as a primary means of exercise. Common social cognitive determinants emerged with self-efficacy identified as the greatest significant predictor of physical activity behavior among college students and was most often operationalized as the perceived ability to overcome barriers to physical activity/exercise. Other salient social cognitive determinants highly correlated with physical activity behavior included: social support from peers, self-regulation, and outcome expectancy value. Variance explained ranged from 7% to 55% among the social cognitive constructs. The major limitation in the majority of these studies remains the self-reporting of physical activity behavior suggesting the need to develop and utilize more objective means of measurement. Collectively these studies suggest further investigation of strategies to increase self-efficacy, recognize gender differences, and develop interventions that target specific personal-social barriers to physical activity. This review of the determinants of physical activity behavior also advocates that interventions focus on the continued enhancement of self-regulatory skills, raising the value of the outcome, and emphasizing peer social support to further impact self-efficacy for overcoming barriers. Another area of emphasis which has been found to be significantly under-represented based on this review of the literature is the emerging adult not enrolled in higher education. A physical activity behavior intervention that recruits both college students and college-aged emerging adults may reveal a new group of barriers to physical activity not yet investigated.

Physical Activity Behavior Interventions

This section reports on intervention research targeted specifically at changing physical activity behavior in college students and emerging adults. Similar to the patterns and determinants search criteria a comprehensive data base search was conducted using PsychInfo (6 matches), MEDLINE (50 matches), PubMed (51 matches), a multi-database search (105 matches) along with a review of reference lists from retained articles produced five interventions and six articles being included. An additional search using the keywords “emerging adult” and “young adult” was also conducted in an effort to identify specific interventions targeting this under-researched population and produced an unsatisfactory outcome. No interventions specifically targeting the emerging adult outside of higher education were identified. Therefore inclusion criteria for this review required that the interventions involve full-time undergraduate college students, incorporate behavioral and/or exercise science principles with the primary intervention lasting at least eight weeks and physical activity behavior as the primary outcome. At the time of this review five intervention studies were identified as relevant for inclusion: TIGER, Fitness for Living (FFL), Project TEAM, ARTEC, and Project GRAD. Additional studies regarding physical educational curriculum in the college setting were found but were dated prior to 1990 and therefore were not included in this review based on the temporal distance from today’s college student population. One intervention termed UNISTEP conducted by Tully and Cupples (2011) was a pilot study of 12 college students to determine the feasibility of conducting a pedometer intervention in the college setting. The study fell short of inclusion criteria for this review with the small sample

size and 6-week duration intervention although briefly the study did report a significant reduction in blood pressure in those students who achieved 10,000 steps per day.

Sailors et al. (2010) presented the TIGER study protocol and baseline results of physical measures in an exercise intervention for college students that spanned five years with a total of 1567 college students participating. The authors hypothesized that an exercise program introduced to college students would improve physiological characteristics resulting in an increase in self-efficacy and exercise skills that would remain into adulthood. The target population was limited to sedentary (defined as exercising less than 30 min/wk for the previous 30 days) college students aged 18 – 35 not actively dieting who enrolled for the course-for-credit intervention. The 30-week intervention (fall and spring semesters) consisted of aerobic exercise training for 40-minutes three days per week plus eight bi-weekly lectures on physical activity and health. Polar E600 heart rate monitors were administered to concur that a minimum of 25-minutes of the exercise was performed between 65% and 85% of each subject's predicted maximum heart rate reserve. Mode of exercise was limited to cycling, treadmill or indoor track walking/jogging, elliptical stepping, stair climbing, rowing, or arm ergometry with mode documented by staff members using direct observation. Results at post-test indicate that those who adhered were younger, weighed less, had lower BMI, smaller hip/waist circumferences, spent more time in the target heart rate zone and exercised at a higher intensity suggesting that healthier subjects had better adherence rates. The most popular mode of activity reported was the elliptical trainer at 48.4% of sessions followed next by running on the indoor track at 29.4% and treadmill running at

15.9%. Exercise intensity was maintained at the appropriate level for 84% of the exercise sessions suggesting participants should achieve physiologic adaptation. The authors concluded from this study that it is the first of its kind to document the duration and intensity of every exercise session providing the opportunity to evaluate adherence and dose and suggested that teaching a lifelong skill of evaluating heart rate to determine exercise intensity may serve to enhance adherence long term. Currently no long-term follow-up data are available.

An intervention to increase walking in college students (N=326 of a possible 1,200; 30% participation rate) using pedometers was delivered through a required health and fitness course called Fitness for Living (FFL) in a large public southeastern university by Jackson and Howton (2008). Researchers hypothesized that steps would increase throughout the intervention and overweight or obese subjects would take fewer steps than normal or under-weight subjects. The intervention required students to purchase and wear a pedometer for a minimum of five days per week for 12 weeks. The first week provided baseline data and then instructors offered students information about suggested number of steps to meet physical activity recommendations. Additionally students were given information on goal setting and other behavior-change strategies during the course. Students were required to chart their number of steps per day on the Wellness Center Web site and at the conclusion of the study were required to complete a questionnaire which assessed demographic information, attitudes toward the Pedometer Project, and past/current physical activity habits. The step log and questionnaire were submitted for a grade at the end of the intervention. For analysis 290 participants were

used due to misreporting of data or taking fewer than 1500 steps per week by 36 subjects. Results showed a significant main effect for time as number of steps increased throughout the intervention from approximately 7,000 steps per day at baseline to 9,300 steps per day at week 12. Separated into three BMI categories of underweight, normal weight and overweight the authors reported that the group main effect approached significance with underweight participants taking fewer steps than normal weight subjects. The researchers concluded that the main finding from this study is an overall increase in the number of steps taken per day during the intervention however limitations exist. No mention of validity or reliability of the measures used was reported and the steps/day was also self-reported. There is no way of knowing if the subjects actually wore the pedometer or simply recorded numbers. In addition intact classes were used without a comparison or control group and this intervention was not theoretically based.

In a report by Buckworth (2001) preliminary results in exercise adherence research in college students was addressed focusing on Project TEAM (Teaching Exercise/Activity Maintenance), a three year project begun in the fall of 1998 at a large Midwestern university. The primary purpose of Project TEAM was to increase the number of college students exercising regularly after completing a physical activity class. Of the sample approximately 93% were aged between 18 and 24 years. The course consisted of a 50-minute lecture once per week and three 45-minute activity labs per week (aerobic dance, jogging, weight training). Results from the intervention have not yet been published. A secondary purpose of Project TEAM was to explore the relationships among outcome variables (resting HR, blood pressure, fasting serum

cholesterol, HDL-C) and psychosocial mediators (components of TTM and SCT). Design of the intervention was driven by Social Cognitive Theory and the Trans-theoretical Model (TTM) of Behavior Change (Stages of Change Model). Those who completed the first 6-month follow-up are included in the data for this report. An important distinction between Project TEAM and other physical activity interventions is that stages were not condensed into “inactive” and “active” groups but rather remained intact. At pre-test it was recognized that students participating in the class were at a minimum in the preparation stage or had been regularly active (action or maintenance). By differentiating exercise stage at the beginning and over time is important in examining the effects of the intervention on outcome variables over time. When grouped together at the end of the quarter there was no change in level of physical activity however when separated by exercise stage from pre-test differences emerged. For students in preparation volume of activity significantly increased by meeting class requirements (135 m/wk), no change occurred for those in action, and those in maintenance experienced a decrease in volume of typical exercise with an explanation offered that the volume of activity required for the intervention was insufficient compared to the typical amount those in maintenance were accustomed to. At 6-month follow-up those who started the intervention in maintenance only partially recovered to their original values indicating a possible negative side effect of the intervention actually reducing levels of physical activity. To assess adherence students were separated into two groups; an adherence group for those in action/maintenance (74.3%) at follow-up and a relapse group for those who regressed to preparation (17.6%) or contemplation (8.8%). At 6-month follow-up

more students who started in preparation relapsed than adhered (59% vs. 41%) and most students who began in maintenance adhered (94.3%). Cognitive processes increased during the intervention and at follow-up for all students regardless of exercise stage which conflicts with the TTM cognitive processes of change which suggests that those in preparation should increase and those in action or maintenance would remain relatively stable (Buckworth, 2001). Social support for exercise from friends was significant and progressed from stage (preparation < action < maintenance) and remained significant for those adhering at six months. Some limitations suggested were that the use of intact classes limits randomization as no treatment or control class was involved and as the course was not required for graduation self-selection bias is introduced. Environmentally those who enrolled in the spring quarter class and retested after summer had greater aerobic capacity and decreased resting heart rate compared to those who participated in the fall quarter. The seasonal effects were found only in those enrolled in aerobic classes.

Leslie et al. (2000) developed, implemented and evaluated the results of the physical activity program called ARTEC (Active Recreation on Tertiary Education Campuses) conducted in Australia. The promotion program was an eight week demonstration project executed at one university compared to a control university that did not receive the program to determine whether a campus-based physical activity program could be adequately implemented. Activities were chosen and offered on campus free of charge to students based on a previous survey assessing student preferences. The primary focus of the program was on increasing student awareness of the benefits of physical activity and promotion of the various activities and facilities available to students which

in-turn would increase levels of physical activity. Cross-sectional data indicated no differences between the respondents from both universities regarding pre-program levels of sedentary, low, moderate, and vigorous activity. Post-test results indicated that the intervention campus increased the proportion of vigorously active students from 21% to 41% and were more likely to be sufficiently active for long-term health benefits by expending more than 800 kcal per week. Of the 839 students who completed the post-program survey 396 participated in class activities during the eight week intervention with aerobics classes being the most highly reported activity. Based on these results the authors concluded that significant improvement in student awareness and increases in physical activity were achieved. Limitations from this study include the inability to determine whether the respondents who completed the first survey were the same as those who completed the second survey, extraneous variables in the non-intervention group were not controlled, physical activity assessments were performed via self-report with no report of validity or reliability of these measures and no long-term follow-up was conducted to determine any sustaining effect of the program. One important suggestion by the authors was to develop partnerships with surrounding community facilities if a campus has limited access or funding for physical activity opportunities on their own campus.

In 1999 Sallis et al. evaluated Project GRAD (Graduate Ready for Activity Daily), a university course designed to promote adoption and maintenance of physical activity (PA) among 338 college seniors (from a population of 7,931; response rate of 9% 1st semester and 4% 2nd semester) who attended an urban university in southern

California transitioning from university to adult roles. This study randomized students to either a course integrating and applying exercise and behavioral science concepts designed to adopt and maintain PA (experimental condition) or a knowledge-oriented course teaching a variety of health issues (control condition). Assessment occurred at baseline, posttest, one and two years after baseline. This study is reporting results from the posttest assessment. Project GRAD integrated constructs from Bandura's Social Cognitive Theory and tailored the program based on the students individual exercise stage of change using Prochaska's Trans-Theoretical Model (TTM) of behavior change. The intervention consisted of a lecture course and lab experience. The lecture course met once per week for 50 min. and taught about health benefits and risks of physical activity, recommendation for physical activity to promote health and fitness, principles of injury prevention and methods of behavioral self-management. Exercise science topics were taught the first half of the class and behavior change methods the second half. The lab experience was comprised of a 110-min weekly lab taught by peer health facilitators separated into three segments: a 15-min demonstration on enjoyable physical activities that require no equipment, a 25-min. behavior change group discussion, and a 45-min. session where students participated in aerobic, strengthening, and flexibility exercises. A maximum of 15 students were permitted in each lab. The labs were also split into two groups based on their stage of change for exercise: those in pre-contemplation, contemplation, and preparation were the 'Inactive' group and participated in lower intensity/duration activities; those in action and maintenance were in the 'Active' group and encouraged them to commit to long-term maintenance and develop a more

comprehensive program. The 7-day PAR interview administered via telephone served as the primary physical activity outcome measure and was mentioned as having substantial evidence of reliability and validity. The results of Project GRAD at posttest revealed no intervention effects for men. For women those in the 'Active' group increased weekly caloric expenditure and both 'Active' and 'Inactive' groups increased participation in flexibility and strengthening exercises. There were no intervention effects for increase in moderate or vigorous aerobic activity among women. At posttest exercise stage of change for women indicated they were more likely to be in the action and maintenance stages compared to control women. The authors indicated the lack of an effect on aerobic-type activities among the 'Inactive' women in this sample should be investigated further as this was an unexpected effect based on the considerable lab time devoted to these activities. The authors suggested the intervention was effective in increasing PA levels in the already 'Active' group but not the 'Inactive' group (a more difficult population to reach). Overall the authors reported the intervention effects as weak with variance explained ranging from .03 to .13 indicating small effect sizes.

In a follow-up analysis of Project GRAD Calfas et al. (2000) assessed longer-term outcomes of both theoretical and physical activity mediators and the relationships between the two on 314 subjects who completed the two-year follow-up. The original sample was 338 college students and in order to be included in the data collection process had to have completed baseline data and attend the first three of 30 classes (a reference to recruitment procedures was provided). Subjects were assessed at baseline, the end of the intervention (15 weeks) and at one and two years from baseline. The post-graduation

intervention lasted for 18 months and consisted of alternating monthly newsletters with one containing exercise science information and the other behavior change procedures. In addition phone calls following a semi-structured script lasting five to 10 minutes were also conducted monthly. The control condition received the “Berkley Wellness Newsletter” bimonthly for 18 months. To compare intervention and control groups at year one and year two a Bonferroni adjustment was conducted. Results for physical activity outcomes at year one and year two showed no significant 3-way interaction effects for either gender and no 2-way interactions for men. For strengthening exercises women participated more at one year compared to control women, but that effect did not carry over for year two follow-up. Additionally there were no significant intervention effects among women for hours of moderate or vigorous physical activity or total energy expenditure. Mediation analysis revealed that intervention women showed an increased use in experiential and behavioral processes of change that was sustained at the one and two year follow-up. No mediator effects were found for men at one and two year follow-up. The authors concluded that Project GRAD was ineffective at maintaining long-term physical activity however showed some improvement among women. Some limitations noted for lack of effect included: use of the 7-day PAR, self-selection bias and that the post-graduation intervention was insufficient to maintain physical activity behavior. Table 2.3 summarizes the interventions targeting physical activity among college students.

Table 2.3
Interventions of PA among College Students

Author	Sample	Design	Purpose	Intervention	Measures	Results
Sailors et al. (2010)	N=1567	Cross-sectional	Exercise to produce physiologic response in turn raises SE	TIGER: The Training Interventions and Genetics of Exercise Response -cardio 3/wk for 30 wk. in THRZ -8 bi-weekly lectures	-Baseline, 15 wk., 30 wk. -body wt -skinfold -circum. -HR, BP, DXA	-elliptical trainer most popular mode -84% of exercise sessions in THRZ -healthier subjects had better adherence
Jackson & Howton (2008)	N=290	One-group pre-test post-test	Assess effectiveness of pedometer intervention to increase PA	FFL: fitness for living -12 weeks -wear ped. 5 d/wk -course lectures on health & wellness -behavior change strategies -data log & questionnaire submitted for grade	-pedometer	Steps increased from 7000 s/d to 9300 s/d from baseline to 12-week follow-up
Buckworth (2001)	Not reported	Quasi-experimental	Increase exercise behavior after completion of academic conditioning PA class	Project TEAM -6 month follow-up Aerobic dance, jogging, or weight training 3x/wk + 50-min. lecture Secondary: examine relationship of mediators and outcome variables	-7dPAR components of TTM	Prep: volume of activity inc. by being in class Action: no change Maint.: decrease in PA Cog. Proc.: increased for all SS: from friend's sig.
Leslie et al. (2000)	N=839	Prospect.	Increase awareness of activities available and increase knowledge of health benefits of exercise	ARTEC -8 weeks -informational promotional materials dispensed across campus	-self reported survey	Intervention group: -VPA inc. from 21% - 41% -396 students participated in class activities -aerobics most popular -expended 800 k/cal per week more than control

Table 2.3 continued...

Sallis et al. (1999)	N=338	Quasi-experimental	Promote adoption & maintenance of PA post graduation	Project GRAD -15 weeks w/ 2 year tapering -course integrating ex. sci. and behav. sci. principles -weekly: -one 50-min. lect. -one 110-min lab	-7dPAR via telephone	No effects for men Women: -inc. cal. Expenditure -inc. flex. & strength ex. -no effects for mod. or vig. PA
Calfas et al. (2000)	N=314	Quasi-experimental	Maintenance of PA post graduation	Project GRAD tapering -18 months of alternating newsletters promoting ex. sci. & behav. Principles -monthly phone calls	-7dPAR	Results from 2-year fu: -strength: women more at 1-yr, but not at 2-yr -no effects for mod. or vig. PA or total energy expend.

Synthesis of Intervention Research

This review of physical activity interventions targeted towards college students and emerging adults has demonstrated the need for more research in this area. Only five college student interventions were identified (TIGER, Fitness for Living, Project GRAD, Project TEAM, and Project ARTEC). The Fitness for Living intervention involving the use of pedometers to increase physical activity demonstrated an increased number of steps taken during the course but presented many limitations. An intact class with no comparison group was used along with self-reporting of steps taken and past/current physical activity patterns with no report of reliability or validity of the measures offered. Additionally the intervention was not theoretically based. The increase in steps taken could be the result of a novelty effect of the device and no long-term follow-up was attempted. Although not mentioned by the researchers a novelty effect could be involved

with wearing the pedometer and the comment of “approaching significance” should be interpreted with caution.

Project TEAM and Project GRAD demonstrate stronger research techniques which provide more confidence in the results of the interventions with the use of quasi-experimental designs with intact classes and both taught similar health and fitness concepts. Only Project GRAD incorporated a control group and the results on outcome variables in Project TEAM have yet to be published. Sample sizes were in the hundreds for each intervention and lasted between eight weeks and three years. Follow-up procedures were established for Project GRAD and TEAM to encourage adherence. Project TEAM and Project GRAD were based on theory and measured some of the salient constructs of SCT and TTM. Outcome variables measured in these interventions included: resting heart rate, high-density lipoprotein cholesterol, blood pressure, and fasting serum cholesterol. It’s interesting that changes in body composition were not assessed. Given the frequency, intensity, and duration of the lab sessions and the length of the interventions it’s plausible that those changes could be significant and serve as more important motivators for college students as the previous review by Keating et al. (2005) reported college students possessing more extrinsic motivators to participate in physical activity like appearance, rather than intrinsic factors for example preventing chronic disease. Since Project TEAM required students to participate in three 45-minute aerobic session per week it would be interesting if those results would present changes in the outcome variables that might influence adherence.

Although these interventions possessed improved design, methods, adequate sample sizes and reported valid and reliable measures the available results are discouraging. In the short-term there were moderate effects on physical activity levels in Project ARTEC and significant positive effects in Project GRAD for women in strength training and flexibility exercises however no positive effects long-term were found for either gender. Variance explained for Project GRAD of 0.03 to 0.13 is considered weak and disappointing considering the extended lab time, although only 45-min per week for physical activity (not necessarily aerobic) was devoted to increasing physical activity and behavioral modification techniques among the 'Inactive' group. While the researchers posited that levels of aerobic activity were high during the intervention, when looking closely at the methods only 45-minutes one day per week was devoted to actual participation in activity and the students could choose between aerobic, strengthening, or flexibility exercises. Therefore the amount of aerobic activity actually being performed cannot be accurately determined. Additionally no information was provided for how the researchers concluded that only the first three of 30 classes needed to be attended for inclusion in the data analysis. It is plausible that this minimal amount of participation does not support the position of adequate mastery experiences to improve long-term adherence. At the 2-year follow-up strengthening exercises for women decreased to non-significant levels.

Leslie et al. (2001) reported that prior to Project ARTEC an assessment of self-reported physical activity determinants among 2,729 university students was conducted. Using Social Learning Theory, predictors of physical activity emerged and included:

social support from family and friends, enjoyment, males being concerned about weight gain (muscle mass) and women concerned with weight (fat) loss re-emphasizing the concern about appearance among college students. The researchers suggested that offering interventions that matched a more homogeneous group may produce better adherence over time. Project TEAM results on outcome variables were unavailable although Buckworth (2001) did report on adherence at 6-month follow-up and found that more students who started in preparation relapsed and most students who began in maintenance adhered. Additionally social support from friends was significant for those who adhered supporting the position of the influence of this construct in successful intervention design.

A consistent deficient theme emerges in these reviewed interventions that centers on a significant lack of actual time performing physical activities or what is called the dose response. It seems plausible that in order to increase levels of physical activity behavior participation among college students requires engaging regularly in that behavior which in-turn would demonstrate change in the social cognitive mediators, provide positive and reinforcing feedback that reciprocally influences physical activity behavior to the extent that participation becomes habitual. Project GRAD attempted to address this issue but examination of the methods reveals only 45 minutes per week of actual physical activity participation and although Project TEAM required a three 45-minute physical activity sessions per week the results on outcome variables are currently unavailable. The Fitness for Living intervention demonstrated an increase in walking among college students but lacked a comparison group and Keating et al. (2005) reported

that college students do not consider walking an activity to improve health or fitness. The ARTEC study was primarily an information-based intervention to promote increased activity levels among college students which did demonstrate effectiveness by increasing the proportion of physically active students compared to a control school that did not receive the program but there is no method for determining if these students were simply more motivated and there was no assurance of the same students completing the pre and post questionnaires.

Social Cognitive Theory

A theory is “a set of interrelated constructs (concepts), definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomena” (Kerlinger, 1986, p. 9). In health promotion theories are utilized to explain determinants that influence behavior and provide means for assisting with behavior change which guides research and application. Therefore theory, research, and practice influence each other reciprocally. McGuire (1983) posits that a theory is most often appraised based on three criteria: internal consistency (producing similar results), parsimony (simple, yet adequate in constructs measured), and plausibility (fits reasonably with existing theories in the field). From an applied and practical perspective theory must present itself as being useful and consistent with regular observations and have testability in real world situations (Glanz, Rimer, & Lewis, 2002). Bandura states that a psychological theory should possess explanatory power based on the following three characteristics: demonstrate predictive capability; achieve significant change in affect, cognition, and

action; and recognize the determinants of behavior and the methods through which effects are generated (Bandura, 1986). Theory then is used by health promotion specialists to guide research and practice along the continuum of development, implementation and evaluation of health promotion interventions.

Historical Perspective of Social Cognitive Theory

Baranowski, Perry, & Parcel (2002) present a timeline for the conceptualization of Social Cognitive Theory which began with the foundational article titled "*Social Learning Through Imitation*" published by Bandura in 1962 regarding social learning and postulated with Walters in 1963 that operant learning (direct rewarding of behavior) was not necessary for learning to occur and rather people learn through modeling and vicarious reinforcement. In 1977 Bandura abandoned some of the principles of traditional learning theory and introduced the cognitive perception of self-efficacy as a critical construct in directing human behavior in the article titled "*Self Efficacy: Toward a Unifying Theory of Behavioral Change.*" Further publications in the lineage of SCT described by Baranowski et al. (2002) include an intervention for heart disease prevention (Farquhar et al., 1977), health education (Parcel and Baranowski, 1981) and worksite interventions (Abrams and Follick, 1983).

Another important milestone in this theoretical conceptualization occurred in 1986 when Bandura disclosed a structure for comprehending human behavior, renaming Social Learning Theory as Social Cognitive Theory (Bandura, 1986). This social cognitive theory as described by Bandura advocates that "human functioning is explained in terms of a model of triadic reciprocity in which behavior, cognitive and other

personal factors, and environmental events all operate as interacting determinants of each other” (Bandura, 1986, p. 18). Reciprocal determinism recognizes the bi-directional relationship between those three components where a change in one factor has implications on the other two. Self-efficacy emerged as the central construct for behavioral change in Social Cognitive Theory (Bandura, 1995). With the emergence of Social Cognitive Theory the mechanistic theories of human behavior that existed prior postulating that humans behave routinely without cognition was refuted and established that humans can be agents of and exercise some control over their lives (Bandura 1997, 2001). In the article “*Social Cognitive Theory: An Agentic Perspective*” (2001) Bandura states that “to be an agent is to intentionally make things happen by one’s actions...the human mind is generative, creative, proactive, and reflective, not just reactive.” Bandura further suggests that this agentic approach to Social Cognitive Theory involves direct personal agency, proxy agency involving others acting on one’s behalf to assist in achieving desired effects and the collective effort of the community at large. This agency model reflects the core principles of Social Cognitive Theory supporting the previous statement that personal factors, the environment, and the behavior mutually interact as determinants of each other; triadic reciprocity.

Framework of Social Cognitive Theory

Social Cognitive Theory provides the framework to attend to the psychosocial forces that affect behavior and the process for supporting behavior change (Glanz et al., 2002). In 1977 Bandura published an article titled, “*Self-efficacy: Toward a Unifying Theory of Behavioral Change*” focusing on the premise that “successful performance is

replacing symbolically based experiences as the principle vehicle of change...cognitive events are induced and altered most readily by experience of mastery arising from effective performance” (Bandura, 1977, p. 191) and that “cognitive processes play a prominent role in the acquisition and retention of new behavior” (Bandura, 1977, p. 192). These statements set the backdrop for the development of personal or self-efficacy and the central role this construct plays in influencing human behavior.

Bandura contends that outcome expectancy defined as the value a person places on the outcome of performing a particular behavior be distinguished from efficacy expectation which is a person’s confidence that they can successfully accomplish the behavior in order to produce the desired outcome. For example if a person places a high estimate of worth on reducing the risk of cardiovascular disease through repeated bouts of aerobic exercise (outcome expectancy) but lacks the assurance to execute the necessary behavior regularly (efficacy expectation) then the behavior will remain unchanged. Bandura further states that “given appropriate skills and adequate incentives, however, efficacy expectations are a major determinant of people’s choice of activities, how much effort they will expend, and of how long they will sustain effort in dealing with stressful situations” (Bandura, 1977, p. 194). The dimensions of efficacy expectations include magnitude, generality and strength (Bandura, 1977). Magnitude is described as the level of difficulty for the particular task and that a linear relationship exists between task difficulty and efficacy expectation level. The more daunting the behavior is perceived to overcome the greater the self-efficacy warranted. Generality refers to the idea that some experiences can build personal efficacy that reaches beyond

the immediate behavioral task and may provide enduring effects. The strength of efficacy expectations directly relates to a person's persistence with behavior change. Bandura cautions about assessing efficacy expectations only at a single point, and presumes that most often people underestimate the difficulty in achieving behavior change. For example while many people may initially think exercising regularly to be a behavior easily undertaken the reality of scheduling, facility availability, financial cost and muscle soreness, or emotional and physical inadequacies in the presence of others are a few examples that may significantly negatively impact a person's personal efficacy.

Based on this social learning process Bandura proposes that efficacy expectations (self-efficacy) are influenced by four major sources of information (Bandura, 1997). Imperative in these sources of self-efficacy is how the individual cognizes the information. Effective interpretation of the information is critical in enhancing perceived self-efficacy. The first source of information is termed *enactive mastery experience* and is considered by Bandura as the most powerful source because through these performances verification of the effort necessary to succeed is revealed. Through repeated reinforcement of positive mastery experiences the ability to overcome minor setbacks is enhanced while perceived efficacy beliefs are strengthened. Bandura continues by suggesting that "development of the cognitive basis of human competencies is facilitated by breaking down complex skills into easily mastered sub-skills and organizing them hierarchically" (Bandura, 1997, pg. 80). For example telling someone to warm-up on a treadmill who has never operated a treadmill before might be identified by that person as a complex skill. Without knowledge and practice of how to operate the

treadmill (sub-skills) a sense of inability and defeat may already have rendered this participant in-eflicacious. With regards to the promotion of regular physical activity providing opportunities for performance accomplishments is critical for initiation and maintenance of the behavior. Bandura contends that mastery of complex behaviors take time to develop and contain periods of advancement, setbacks and stagnation. Weight loss programs are a good example of this fluctuation where subjects may lose weight early on, then plateau or remain stationary for months before their body begins to change. Having a strong sense of self-eflicacy is necessary for sustained effort during times of adversity.

The second source of information termed *vicarious experience* involves seeing others performing the behavior successfully which in-turn enhances an individual's personal eflicacy. This modeling of similar others raises a person's eflicacy beliefs that they also possess the necessary characteristics and abilities to successfully complete the task. In physical activity interventions identifying and recruiting participants that possess similar characteristics (i.e. overweight/obese individuals) and have similar fears may further enhance cognitive appraisal for success. Caution is advised however because if the model fails then the observer may associate that failure as support of their own perceived inadequacies which emphasizes the importance of cognitive processing. Attributes also affect the vicarious experience and cognitive interpretation. Bandura states that "models of similar race and gender are viewed as more credible and instill stronger eflicacy beliefs and behavioral intentions than do models of different race and gender" (Bandura, 1997, p. 98).

Verbal persuasion described by Bandura as the third source of information that influence's efficacy expectations suggests that verbal feedback promoting a person's abilities can help increase effort and maintenance. Conversely negative verbal feedback may reinforce inadequacies which lower perceived self-efficacy and reduces participation. Bandura suggests that the development of self-regulation is important to combat negative feedback through increased confidence and less concern about what others may indicate about their abilities ultimately leading to self-improvement rather than comparison to others.

Physiological and affective states (emotional arousal) described as the fourth source of efficacy expectations has influential power on behavior. Fearful thoughts can trigger defensive behavior that further exacerbates emotional arousal which inhibits learning and performance (Bandura, 1977). This heightened state of arousal may trigger avoidance behavior that further reduces coping skills. Through management of emotional arousal by practicing behavioral management techniques the fear can be dissipated and the positive behavior may ensue. "The more varied the circumstances in which threats are mastered independently, the more likely are success experiences to authenticate personal efficacy and to impede formation of discriminations that insulate self-perceptions from disconfirming evidence" (Bandura, 1977, p. 202). If anxiety about performing a particular behavior is diminished a greater likelihood of success will ensue. Furthermore proper cognized interpretation of physiological states will enhance perceived self-efficacy. Bandura suggests that those individuals with high physical efficacy will sense less physiological strain during activity and generally report a more

positive experience. Mood is also described as having an impact on affective state where a positive mood can conjure up thoughts of past successful performances impacting perceived self-efficacy positively.

A significant part of developing efficacy expectation is in the cognitive processing of the information received. How this information is appraised strongly influences a person's confidence in accomplishing behavior change. According to the research reviewed by Bandura, "the stronger the efficacy expectations, the higher was the likelihood that a particular task would be successfully completed" (Bandura, 1977). This theory of behavior change founded on self-efficacy suggests that "people process, weigh and integrate diverse sources of information concerning their capability, and they regulate their choice behavior and effort expenditure accordingly" (Bandura, 1977, p. 212).

Within this social cognitive view, Bandura suggests that the nature of people can be defined possessing five basic capabilities. *Symbolic capability* posits that people can adapt to their environments based on experiences which then influences future action. Bandura further states that people often test possible solutions symbolically rather than through continued trial and error. This may present lasting cognitive imprints that shape forms of action. *Forethought capability* suggests that people can anticipate possible outcomes based on the proposed action and act accordingly. As stated by Bandura, "future events cannot serve as determinants of behavior, but their cognitive representation can have a strong causal impact on present action" (Bandura, 1986, p.19). *Vicarious capability* is revisited here as one of the four major sources of how humans receive information. In learning from the behavior of others without necessarily engaging in that

behavior removes the necessity of trial and error thus saving time and energy. *Self-regulatory capability* is described as playing a central role in SCT. It suggests that human behavior is regulated by a person's own set of internal standards not necessarily for only the approval of others. *Self-reflective capability* allows for the analysis of experiences cognitively. Through this reflection people evaluate their cognitions and this analysis coupled with efficacy beliefs shapes the course of action, what effort is put forth and the persistence or sustainability of the behavior.

Key Constructs of Social Cognitive Theory

Self-Efficacy

The construct of personal or self-efficacy remains the principle component on which Social Cognitive Theory is founded. A person's cognitive affect of their ability to perform a particular behavior or overcome barriers to that behavior is paramount in determining how much exertion will be applied and maintained to accomplish a given undertaking. The level of performance reached is partly determined by this personal effort. If a person lacks the confidence in initiating or maintaining a healthful behavior then they will most likely fail. Bandura (1977) suggests that people engage in activities they perceive as capable of performing and avoid more challenging situations that are cognitively expressed as beyond their capacity. The stronger the perceived self-efficacy the more likely a person will express more effort in accomplishing the task and will be more likely to maintain the choice behavior (Bandura, 1986). This ability to exercise control over one's health habits is described as "the foundation of human motivation and action" (Bandura, 2004, p. 144). Before a person even considers changing a negative

health behavior their belief in whether they have the motivation and proper regulatory skills to achieve this change is central to human functioning (Bandura, 1997).

Self-Regulation (self-control)

Bandura states that “Health habits are not changed by an act of will. Self-management requires the exercise of motivational and self-regulatory skills” (Bandura, 2005, p. 246) and further suggests that self-regulation operates or is influenced under three sub-functions: self-observation, judgmental process and self-reaction. Self-observation is synonymous with self-monitoring and involves a person being knowledgeable of and attending to their current behaviors. Bandura further contends that “Success in self-regulation, therefore, partly depends on the fidelity, consistency, and temporal proximity of self-monitoring” (Bandura, 1986, p. 336). Self-observation allows for the establishment of setting realistic goals and evaluation of subsequent changes in behavior. The judgmental sub-function influences self-regulation by which a person interprets a particular behavior as either positive or negative based on established internal standards and these standards are often influenced by social norms. People begin to critique their behaviors based on personal standards, values and social expectancy. Self-reaction is developed by creating incentives to achieve behavior change and these rewards serve as motivators which enhance the effort a person will put forth in order to successfully engage in the targeted behavior (Bandura, 1986). Self-regulation includes then the “self-monitoring of health-related behavior and the social and cognitive conditions under which one engages in it; adoption of goals to guide one’s efforts and strategies for realizing them; and self-reactive influences that include enlistment of self-

motivating incentives and social supports to sustain healthful practices” (Bandura, 2005, p. 246).

Behavioral Capability

This construct refers to a person possessing the necessary knowledge and skills to properly execute a targeted behavior. This concept goes beyond just learning the skill, but necessitates that person be able to successfully perform it (Glanz et al., 2002).

Through mastery experiences a person further develops behavioral capability.

Behavioral capability can be highly influenced by perceived self-efficacy.

Outcome Expectations (motivation)

Bandura (1986) describes outcome expectations as antecedent determinants of behavior or the forethought about what outcomes will occur as a result of engagement in the targeted behavior. “Through the exercise of forethought, people motivate themselves and guide their actions in anticipation of future events” (Bandura, 2001, p. 7). By developing outcome expectations people can use future desires to impact present behavior. These expectations are learned through performance attainment, vicarious experience, social persuasion and physiological arousal (Glanz et al., 2002). Physical outcomes may include the gratifying and disinclined effects of the behavior in addition to tangible losses and profits (Bandura, 2004). The relationship one has within their social environment also affects outcome expectations through the approval or condemnation of others regarding the behavior in question (Bandura, 2004).

Outcome Expectancies (incentives, goals)

Outcome expectancies are the values placed on a certain outcome. Without incentive there may be little motivation to engage in a particular behavior. “Cognized goals rooted in value system provide further self-incentives and guides to health behavior” (Bandura, 1997). If a person places a high value in attaining a certain goal they will be more inclined to extend the necessary effort to accomplish the task even in the presence of barriers and competing interests. Glanz et al. (2002) suggest that people will choose to perform activities that capitalize on positive outcomes or minimize negative ones.

Reinforcements (rewards)

These involve the responses to a particular behavior that may increase or decrease the probability that the behavior will continue (Glanz et al., 2002). The three types of reinforcement suggested in SCT operate through direct reinforcement, vicarious reinforcement (observational learning) and self-reinforcement further sub-divided into intrinsic and extrinsic reinforcement (Glanz, et al., 2002). Extrinsic rewards are external to the person and may provide early motivation to adopting a particular positive behavior however the development of intrinsic reinforcement where a person performs a task for self-satisfaction may establish the persistence of the behavior (Bandura, 1986). For example a person who begins an exercise program may be motivated by extrinsic rewards of losing weight or looking better, but without developing internal self-worth of the action and reasonable goals it may be unlikely that this new behavior will be sustained.

Environment (social support)

The environment refers to specific objective factors that are external to the person that influence behavior (Glanz et al., 2002). For example the physical environment might include the weather, place of residence, or availability to resources whereas the social environment may encompass those interpersonal relationships with family, peers, co-workers and friends that pose to influence behavior. This social network can have significant impact on shaping a person's behavior through modeling and reinforcement. The situational environment refers to the person's cognitive assessment of their environment which Glanz et al. (2002) describes as the perception of time, place, physical attributes, activity, participants and the role of the individual within the particular situation.

Measurement of Physical Activity Behavior

The accurate measurement of physical activity behavior is important and necessary for capturing population trends, enhancing interventions, establishing a baseline of activity level and motivating people to improve their health. This issue of accurately measuring physical activity behavior in large scale populations within a field setting remains a challenge for researchers. Developing valid and reliable instruments for assessing physical activity behavior remains a critical component of the research process. Of the various tools available which include: direct observation, accelerometry, heart rate monitoring, self-report and pedometry to name a few all present their own inherent advantages and disadvantages. For example some tools claiming to measure physical activity behavior like heart rate monitoring are really only measuring an estimate of

caloric expenditure not necessarily physical activity behavior. Others like pedometry fail to capture adequately the dimensions of physical activity behavioral scientists are most interested in which include frequency, intensity, time and type of activity. As researchers we need to be careful in identifying the question we seek, define it appropriately and then find a combination of tools that will help to best answer that question. The purpose of this review of the literature is to explore and describe various methods of physical activity measurement, present what that research indicates along with a synthesis of the literature for each measurement tool and finish with an overall synthesis of the measures described.

Direct Observation

Direct observation is a procedure for measuring free-living physical activity behavior in order to quantify and analyze the various dimensions of physical activity. This method allows the researcher an eye-witness account of the frequency, intensity (although subjective in nature), time and type of physical activity occurring in real-time. With the advancing of technology and use of small portable computers data can be gathered instantaneously and analyzed. Pate (1993) describes observation measures as being face valid and highly reliable with inter-observer agreements between 84 and 98% indicating reliable results among well-trained observers. The author also mentioned direct observation's advantage of being able to record the specific mode of activity and the environment in which the activity occurred. Direct observation has been used extensively with children as opposed to other measures like self-report and interviews because the ability of a child to recall dimensions of physical activity accurately is

lacking. Welk et al. (2000) in their analysis of measurement issues for the assessment of physical activity in children described direct observation procedures as a highly useful technique to categorize children's activity. In addition the authors mentioned that direct observation although time consuming is a viable criterion measure for the validation of other instruments. In a review article by Oliver et al. (2007) advantages of using direct observation were described. The authors concluded that the ability to gather detailed information on activity pattern's in various settings, the measurement of upper-body movement, eliminating the need for recall and their un-obtrusive nature are all strengths for using direct observation to assess physical activity behavior in children.

Although in theory this method seems quite feasible with the ability to directly observe the behavior, like any other measurement tool or procedure there are limitations. One important factor to consider when using direct observation is determining the sampling method. This involves deciding which subjects to watch when and how to record the behavior and must be determined a priori. Continuous sampling would supply the most information but the ability of the researcher to accurately record all facets of activity is cumbersome. Time sampling is often the method of choice and involves decision rules that dictate the amount of time to be spent observing the behavior and the time necessary to record the behavior. Another difficulty when using direct observation is the amount of time necessary to train observers. In order to be reliable the observers must develop extensive knowledge of the procedures for observing and recording physical activity behavior along with being properly trained and re-trained to avoid error. Children are also highly reactive and could change their behavior if they know they are

being observed. This review of literature produced no direct observation system available for an adult population.

Most of direct observation literature has focused on children for reasons mentioned previously and very little research has focused on the adult population. In 2008 Floyd et al. conducted a study to assess levels of physical activity in neighborhood parks and determine if racial/ethnic and income composition influenced those levels across all ages. Observation of 10 parks in Tampa, FL and 18 parks in Chicago, IL was conducted using a modified version of SOPLAY. Observation codes included age group, gender and activity level. The authors mentioned that construct validity of the activity codes was already established in previous studies. Inter-observer agreement ranged from 0.79 to 0.97. The results for physical activity behavior indicated that 65% of park users engaged in sedentary behaviors, 23% were observed walking and 11% participated in vigorous activity. The authors concluded that since parks are often mentioned as areas for potential physical activity they should be designed in such a way that would enable and encourage more participation thus reducing the percentage of park users engaged in sedentary activity while visiting the park.

Synthesis of Direct Observation

This review of the literature has presented direct observation as a system or procedure for assessing various dimensions of physical activity behavior among population based research. The general characteristics of direct observation allow the researcher an opportunity to record in real-time the frequency, intensity, duration, and type of physical activity being performed. Some of the advantages for using direct

observation include: the elimination of recall bias, their relatively unobtrusive nature, the minimal amount of needed equipment for data collection and the ability to capture more fully the dimensions of physical activity. The greatest limitation stems from the extensive training of the observers. A study by McKenzie et al. (1991) revealed that observer training lasted for 42 hours and in addition, re-training and re-assessment was necessary throughout the study. Other limitations include the potential highly reactive nature of children, observation may become subjective in nature (relating to observer training), the continuous recording of activity is not possible and no system currently exists for the study of an adult population. As with other methods of measurement for physical activity behavior finding the best tool or combination of tools is critical in answering the research question. Direct observation provides researchers with a valid and reliable technique to evaluate and collect data with regards to physical activity but is highly population specific. The research question must drive the measurement procedure and scientists must be open to exploring various instruments to avoid narrowed thinking that one particular method for measuring physical activity behavior is the 'gold standard' for all research.

Self-report / Recall Instruments

Recall instruments in physical activity behavior research tend to be the most widely used in large scale population studies for their low cost, ease of administration and minimal time requirements. Their ability to assess frequency, intensity, time and type of activity, along with providing an estimate of energy expenditure serve as distinct advantages to other measures of physical activity that may only provide information

concerning one dimension of physical activity. It is also evident that there exists no “gold standard” of measurement to which researchers can confidently agree will measure physical activity behavior perfectly for every population and setting. With that investigators are left with identifying what measure or measures will most accurately address their research question. Once that question has been identified the operational definition of physical activity must be clearly stated in order to investigate the best method with which to measure the outcome.

Seven-day recalls are paper and pencil instruments used to assess the physical activity behavior of a person over the previous seven days. The subject is given the instrument and asked to complete the information requested which often includes recalling the frequency, intensity, duration and type of physical activity performed. Washburn et al. (2003) sought to validate the Stanford 7D-PAR with the accuracy of energy expenditure estimation using doubly labeled water (DLW) in 46 relatively healthy, moderately obese, sedentary young adults aged 18 to 33 years. Body composition involving body weight, height and percent body fat using underwater weighing and peak oxygen uptake using the modified Balke treadmill protocol were assessed to show their association with reporting error when using the 7D-PAR. A 14-day period was conducted for the evaluation of DLW. Two trained interviewers administered the 7D-PAR during a 15-20 minute session. By having both interviewers conducting 10 interviews on the same person and comparing those results interviewer reliability was established with an intra-class correlation of 0.85 reported. Time spent in sleep, moderate, hard and very hard physical activities for the previous seven days was

recalled by the subjects and recorded by the interviewers. Using the average hours per day spent in each category multiplied by an assigned MET value provided an estimate of total daily energy expenditure. The sum of those energy expenditures minus resting metabolic rate which, was measured in the laboratory prior to the beginning of the study, indicated an estimate of physical activity energy expenditure from the 7D-PAR. The results showed that the 7D-PAR underestimated mean daily energy expenditure by approximately 17% and this underestimation increased as total daily energy expenditure (TDEE) increased but that no significant differences were found. The correlation reported between DLW TDEE and 7D-PAR TDEE was 0.58. When separated by gender the 7D-PAR underestimated energy expenditure in men by 20% and overestimated energy expenditure in women by 16%. Physical activity energy expenditure (PAEE) for the 7D-PAR was underestimated an average of 56% and this underestimation also increased as physical activity levels increased. The PAEE between the two measures were not significantly correlated ($r = 0.07$). In women the higher the percent fat the greater the overestimation of total daily physical activity from the 7D-PAR ($r = 0.52$). The authors concluded that the 7D-PAR can establish an estimate of the mean PAEE or TDEE in a large group but variability of the individual limits its use for estimating energy expenditure in an individual.

Leenders et al. (2001) sought to establish the accuracy of four methods that measure physical activity and related energy expenditure in 13 healthy women who wore three different activity monitors for seven consecutive days and completed a recall instrument on the final day. These four measures were compared to doubly labeled water

for TDEE. The Tritrac and CSA accelerometers were worn and PAEE was calculated from activity counts with minute-by-minute energy expenditure reduced to an average per day. Average daily energy expenditures and steps were also assessed using the Yamax-Digiwalker-500 pedometer. The 7-d PAR consisted of an interview format in which the same investigator conducted all interviews. The 7-d PAR asked the subject to estimate over the previous seven days how much time she spent sleeping and engaging in moderate, hard and very-hard intensities. Light intensity activity was calculated as the amount of hours remaining after summing sleeping, moderate, hard and very-hard intensities. These indications were then converted to MET levels and each MET value was then multiplied by the time spent in each category and then divided by seven to estimate daily PAEE. Pearson product-moment correlations and paired t-tests were used to assess differences in PAEE and DLW. Results for group physical activity recall (PAR) scores indicated no significant difference from DLW in estimating PAEE. Individually PAR showed overestimation of PAEE in sedentary subjects and underestimation in the more active subjects. The authors contributed this finding to the possibility of underreporting moderate intensity physical activity by the more active subjects.

In 2006 Macfarlane et al. examined the convergent validity of six measures of physical activity from a convenience sample of 49 healthy Chinese subjects who wore all four activity monitors for at least 600 waking min/day and completed daily PA-logs plus a 7-day recall on the eighth day, all while engaging in their normal daily routines. A Polar HR-monitor was worn daily by the subjects and the heart rate range cut-points

were: light activity (20-39.9% HRR), moderate activity (40-59.9% HRR) and vigorous activity (> 60% HRR). The uniaxial MTI accelerometer established activity count cut-points as follows: light = 693 – 1951, moderate = 1952 – 5724 and vigorous > 5725. The triaxial Tritrac accelerometer cut-points were: light = 650 – 1210, moderate = 1211 – 2893 and vigorous > 2894. A Yamax SW-700 pedometer was used to calculate steps per day. The PA-log was completed at the end of each day and included all activities lasting 10 minutes or more. The activities were then assigned a MET value based on the Compendium of Physical Activities. The short IPAQ-C was used for the 7-day recall assessment with total minutes reported for walking. A MET value was then assigned for the various intensities of walking which included: 3.3 for light activity, 4 for moderate and 8 for vigorous. The descriptive results indicated that percentage of time spent in moderate and vigorous activity was equivalent across the six instruments. The IPAQ-C produced significantly higher estimates of mean moderate activity (854 min) compared to the Tritrac and MTI estimates (311 and 302 min). The IPAQ-C also produced the highest mean estimates of vigorous activity (126 min). The correlation coefficients between each instrument for intensity were weak to moderate ($r = 0.3 - 0.7$). For duration the IPAQ-C demonstrated a moderate correlation ($r = 0.6$). The authors conclude that there is poor convergent validity across the six instruments studied and that population-specific cut-points may be necessary to establish appropriate thresholds for light, moderate and vigorous activity. This information supports the concept that finding the best method of measurement for a particular study is crucial in identifying a real effect.

Strath et al. (2004) attempted to compare recall estimates of intensity-specific physical activity using the College Alumnus Questionnaire Physical Activity Index (CAQ-PAI) versus the heart rate-motion sensor technique (HR+M) over seven days of daily activity. The CAQ-PAI estimates kilocalories expended in leisure-time physical activity which includes: city blocks walked, flights of stairs climbed, and sports, recreation, and other physical activities. Participants were obtained from a convenience sample and included 12 men and 13 women between the ages of 20 and 56 years. Subjects were assessed using laboratory testing that included: anthropometric measures, body composition, heart rate, and VO_2 during leg and arm testing. After initial assessments participants were monitored using a CSA and Polar Vantage HR monitor for seven consecutive days. Subjects were encouraged to follow their normal routine. At the completion of monitoring the participants completed the CAQ-PAI and each activity was then assigned a MET level using the Compendium of Physical Activities. Although mean levels of moderate and vigorous physical activity did not differ significantly individual differences were significant using the CAQ-PAI indicating inaccuracies in estimating those intensities. Light intensity physical activity was underestimated using the CAQ-PAI. Correlation coefficients between the HR+M technique and the CAQ-PAI for all physical activity intensities were between $r = 0.20 - 0.47$. The authors concluded that this inability to accurately assess light intensity activity remains a challenge in estimating total daily physical activity levels.

Fuller et al. (2007) compared energy expenditure measured by doubly labeled water (DLW) with measures of energy intake, heart rate monitoring, accelerometry, 24-h

physical activity diaries and 7-day physical activity recall (PAR). Fifty-nine volunteer subjects agreed to stay continuously in the feeding behavior suite of the Rowett's metabolic facility for 14 consecutive days. Three age groups of 20-35.9 years, 36-50.9 years and 51-66 years and two BMI categories of <25 and >25 kg/m² were recruited via advertisement. The subjects were provided as much food and drink as they wanted that closely matched their normal dietary intake whenever they wanted. During their stay subjects were asked to maintain their normal daily behavior. During the first 2 days subjects were given a mandatory maintenance diet and were introduced to the equipment and questionnaires that would be used during the study. Doubly labeled water served as the 'gold standard' measurement of energy expenditure. Subjects provided urine samples daily. Resting metabolic rate was measured using indirect calorimetry in the morning after a 12-hour fast. Subjects were instructed to not engage in strenuous activity the day before the RMR measurement. Heart rate was assessed during waking hours using a Polar Sport Tester heart rate monitor. Each day's energy expenditure was summed to provide an estimate of total energy expenditure. The Caltrac accelerometer was worn during waking hours with the data being downloaded daily and energy expenditure calculated. Physical activity diaries were completed for each 24-hour period. The listing of activities was ranked according to energy cost and a daily measure of energy expenditure was estimated. The PAR was administered on days 8 and 15 by the same trained interviewer. Subjects recalled physical activity participated in each day. A minimum of 10 minutes was required for the activity to be included in the data. The intensity of the activity included was rated as: moderate, medium and very hard. The

subjects were also asked if any strength or flexibility exercises were performed and for what duration. The correlation coefficients for comparing all measures with DLW for estimating energy expenditure were approximately 0.6. When estimating energy expenditure as a multiple of resting metabolic rate the correlation coefficient for the PAR was 0.28. The authors concluded that, “in the case of the activity diaries and recalls, their performance was so weak that the methods as used can be considered of negligible value”.

The validity and reliability of a physical activity recall instrument among overweight and non-overweight men and women was conducted by Timperio et al. (2003). The purpose of the study was to assess the test-retest reliability and concurrent criterion validity of a 1-week recall instrument which was modified from the Active Australia Survey which assess frequency and duration of walking, other moderate-intensity activity and vigorous-intensity activity to include measures of leisure, occupational, transport-related, and household physical activity compared to the MTI accelerometer. Another aim of this study was to determine if overweight women and men overestimate physical activity intensity. The procedures involved administering a 1-week physical activity recall questionnaire to 118 adults on three occasions. For reliability the first and second administrations were three days apart and for concurrent criterion validity the subjects wore an accelerometer for the seven days. Results indicated that regardless of weight status reliability for the two administrations was greater than 90%. The overweight subjects tended to overestimate participation in moderate and vigorous intensity activities with correlation coefficients of 0.46 and 0.40

respectively. The authors concluded that the recall instrument is valid and reliable for use among adults but cautioned that any recall measure might vary among different weight populations. For example overweight individuals might perceive an activity as being more vigorous even though it may be moderate in nature. They may simply lack the knowledge and physical feeling of the difference between moderate and vigorous activity.

Sallis and Saelens (2000) conducted a review of physical activity self-report instruments developed and/or used in the 1990s to summarize the results on content validity, test-retest reliability and criterion-related validity. Seventeen instruments measuring youth physical activity behavior were identified. The time frame for recall varied from one day to three months and the ability to assess any or all of the four physical activity dimensions (frequency, intensity, time, and type) varied as well. Re-test reliability ranged from 0.60 to 0.98. Validity correlations for self-administered surveys, interviews and proxy reports were 0.07 – 0.88, 0.17 – 0.72, and 0.40 – 0.77 respectively. Of the seven instruments reviewed for young-to-middle-aged adults test-retest reliability was relatively high for those with recalls less than one month ($r = 0.34 - 0.89$). For adults moderate physical activity scores had lower reliability than vigorous physical activity scores. Assessing sedentary behavior, household activities, transportation, and work related activity were rarely measured. Adults' total physical activity validity correlations ranged from 0.14 to 0.36, except for the PAR which posted validity correlations of 0.50 and 0.53. In older adults four measures were identified with

reliability ranging from 0.56 to 0.93. Correlations of 0.58 and 0.62 were recognized with DLW.

A seven day physical activity recall instrument developed by Petosa (1993) is stronger in capturing physical exercise than the previous recall instruments in this review. This instrument measures frequency in days, the intensity of exercise as moderate or vigorous, time in minutes, type of exercise performed and whether the exercise was planned or unplanned. In a sample of adolescents this instrument demonstrated strong 1-week test-retest reliability of $r = 0.72$ for moderate exercise and $r = 0.82$ for vigorous exercise. Using seven consecutive previous day physical activity diaries the 7d-PAR demonstrated a correlation of 0.89 for moderate exercise and 0.92 for vigorous exercise. The assessment of physical exercise by using the self-administered 7d-PAR (seven day physical activity recall) with this valid and reliable instrument is well suited for an emerging adult population.

Synthesis of Self-report / Recall Instruments

The purpose of this review was to assess the validity and reliability of various recall physical activity self-report instruments. One of the greatest disadvantages in measurement of physical activity is that there is no single method to fully quantify a person's activity level and that most of the instruments fail at measuring lower levels of physical activity which might contribute considerably to total daily energy expenditure. Future direction for measurement in physical activity will continue to challenge researchers to develop instruments that are precise, cost effective and feasible in large scale population studies and these instruments must continue to be validated. The costs

associated with measuring physical activities with the most sensitive instruments is often not feasible among large scale studies therefore precision is sometimes compromised to maximize the reach of an intervention. Highly accurate testing of human physical activity behavior is often restricted to a laboratory setting with very small sample sizes which offers very little practical application and generalizability. For example the Fuller et al. (2007) study in which participants were restricted to the laboratory for 14 days, not allowed to leave, but then were asked to go about their normal daily routine. Being locked in a laboratory is hardly “normal”.

From this review the 7-d PAR is most likely the best viable instrument to use provided the reliability and validity are established for the particular population with which the instrument will be administered to. Within this review several themes emerged regarding the employment of seven-day recall instruments. Most notably among the studies was the consistency with which a moderate correlation was often reported for total daily energy expenditure ranging from 0.30 to 0.61. It was also well documented in these studies that individual variation showed greater variability in underestimating and overestimating various intensities of activity although when using recall instruments we are often concerned about group data rather than individual information. If we are interested in individual data then we may choose an instrument that is more precise and in turn significantly more costly. It remains however quite difficult to extrapolate much information from an individual and apply that to a target population. A commonality occurred in which often times sedentary people overestimated moderate intensity activity while more fit individuals underestimated moderate intensity activity. Vigorous intensity

activity was also more often overestimated in overweight or sedentary individuals. The correlations for these intensities ranged from 0.20 to 0.35 for light, 0.15 to 0.68 for moderate, and 0.10 to 0.72 for vigorous. The research reviewed also indicated an inability to capture activity performed at the lower end of the physical activity continuum which often includes more sedentary and light intensity activities. It is quite possible that these lower intensity levels of activity are contributing to the physical activity energy expenditure and ultimately affecting total daily energy expenditure. This total energy expenditure can have an impact on health but we have yet to develop a means to capture that effect. However if we are interested in physical activity that will have an impact on health related outcomes then we need to assess participants at the moderate and vigorous intensity levels which the 7d-PAR by Petosa captures well. The seven day physical activity recall instruments reviewed showed moderate correlations to other measures of physical activity therefore can be deemed valid and reliable for the particular populations in which they were developed for.

Pedometry

According to Bassett and Strath (2002) pedometers may be useful in physical activity behavior research for the following reasons: walking is a very popular form of physical activity in the U.S.; a major portion of energy expenditure reported on self-report instruments is walking; health benefits can be achieved through regular walking; and individuals can monitor themselves without the need of specialized personnel, facilities or equipment. For reasons of low cost, non-obtrusiveness and ease of administration and use by the subject pedometers may offer a more practical alternative

for measuring physical activity behavior compared to doubly labeled water, accelerometry or other measures. What is important to remember is that pedometers measure number of steps so when compared to other instruments for validity and reliability those instruments that measure steps or counts should correlate well. However when measuring other components like extrapolating energy expenditure from the number of steps taken more error in measurement is likely producing smaller correlations.

In a review of the literature on pedometers Tudor-Locke & Bassett (2004) sought to establish general indices to determine how many steps per day are enough for health benefits to be achieved. With the goal of 10,000 steps per day becoming the norm of what should be achieved the authors searched the literature to substantiate this claim. Although none of the studies reviewed indicated a decrease in mortality from accumulating a certain number of steps per day some of the research indicates that achieving greater than 10,000 steps per day may reduce body fat and lower blood pressure. From the review Tudor-Locke & Bassett (2004) recommend the following classifications for steps per day: < 5000 steps/day = sedentary; 5000-7499 steps/day = low active; 7500-9999 steps/day = somewhat active; > 10,000 steps/day = active; and > 12,500 steps/day = highly active. With these recommended indices those that use pedometers to measure physical activity can classify their current activity level.

In 2006 De Cocker et al. conducted a pilot study to determine if the Stepping Meter is a valid instrument in measuring the free living environment of adults. The sample consisted of 35 healthy adult volunteers who agreed to wear five Stepping Meters

and one Yamax Digiwalker (the criterion measure) for six days until all 30 Stepping Meters had been evaluated. The difference in step counts from the Stepping Meters and the Yamax Digiwalker after the six days were computed as percentage deviations from the Yamax. For validity to be established a maximum of 10% deviation from the Yamax was permitted. The results indicate that of the 973 Stepping Meters tested only 25.9% met the validity criterion. Of the 74.1% that were invalid 65% of those overestimated step counts while 35% underestimated the step count. The overestimation might be explained by the Stepping Meter's ability to record movements such as sitting, bending and kneeling; all non-stepping movements which indicates the sensitivity and inaccuracy of the instrument is rather high. As a result of this validity issue the researchers concluded that the Stepping Meter would not be used in their future study.

Crouter et al. (2003) evaluated the reliability and validity of 10 electronic pedometers for measuring distance traveled, kilocalories expended and steps taken at different treadmill walking speeds. For this study 10 apparently healthy adults volunteered to walk on a treadmill at speeds of 54, 67, 80, 94 and 107 m-min (5 minutes at each speed with a 1-min rest period between speeds) while simultaneously wearing each brand of pedometer. Indirect calorimetry using a TrueMax 2400 measured energy expenditure. Actual steps were also recorded by an investigator using a hand counter. Resting metabolic rate (RMR) was also assessed using the TrueMax 2400 after an overnight fast. The RMR was subtracted from the measured gross calories during treadmill walking to obtain calories expended during the treatment. The intraclass correlation coefficients for the pedometers ranged from 0.57 to 0.99 with eight out of 10

pedometers indicating an ICC above 0.81. With respect to walking speed underestimations occurred most often at 54 and 67 m-min. For distance traveled overestimation commonly occurred with slower speeds and underestimation at higher speeds. The most accurate speed for most pedometers in the study was 80 m-min. The information regarding kilocalories expended was difficult to determine whether the pedometers were predicting gross or net calories. The authors concluded that if the mode of activity is walking then pedometers are more than likely estimating gross kilocalories expended but lack the sensitivity to capture energy expenditure in other types of physical activity separate from walking. The authors also concluded that when predicting steps, distance and gross kilocalories expended while walking, the Yamax Digiwalker SW-701 is the most accurate.

In 2003 Le Masurier and Tudor-Locke investigated the concurrent validity of the dual-mode CSA accelerometer and the Yamax pedometer to the number of steps taken on a treadmill at five different speeds and while riding in a motorized vehicle. In study one 20 healthy adults volunteered to walk on a treadmill for five minute bouts of speeds of 54, 67, 80, 94 and 107 m-min. The number of steps taken were also counted by an investigator and verified by videotape. In study two 20 participants were monitored while riding in a motor vehicle on a paved road for a total distance traveled of 20.4 miles. Any steps detected during study two would be considered measurement error. The results indicated for study one that the Yamax detected fewer steps at the slowest treadmill speed but at the other four speeds, neither instrument differed significantly between actual number of steps taken. In study two both instruments detected steps taken

with the CSA recorded 17 more times the steps taken than the Yamax. The ICC for the driving segments for the CSA and Yamax were 0.79 and 0.88 respectively. With the Yamax failing to record steps at the slowest treadmill speed this instrument may have limited utility in an elderly population that may walk at slower pace.

Tudor-Locke et al. (2002) conducted a review of the literature to assess the convergent validity for using pedometers to assess physical activity with accelerometers, observation, energy expenditure, and self-report. In this article convergent validity was defined as “the extent to which the output of an instrument is associated with that of other instruments intended to measure the same exposure of interest.” In a figure using concentric circles provided by the authors the expected association between pedometers and other measures of vertical acceleration like walking or running were presented. The innermost circle included accelerometers while the outermost circle represented fitness, anthropometric and metabolic measures. The median correlation for accelerometers reported was 0.86 with a range from 0.50 to 0.99. The lowest correlation was found in a classroom setting where much sitting occurs. A positive correlation was found for time in observed activity with a median correlation of 0.82 and a range from 0.42 to 0.97. Reduced accuracy was consistent with slow walking speeds. The correlation with energy expenditure varied from 0.46 to 0.88 with a median correlation of 0.68 reported. Depending on the measure of energy expenditure used, conditions, expression of outputs, and taking into account gender, age, and body mass may confound this correlation however heart rate and indirect calorimetry produced correlation ranges from 0.46 to 0.88 and 0.49 to 0.81 respectively. The agreement between self-report and pedometers ranged

from 0.02 to 0.94 with a median of 0.33 and seems to be dependent upon type of self-report used, individuals assessed and outputs. The 7-d PAR indicated the highest correlation of 0.94 for a sample recruited specifically for ambulatory activity. For proxy report the median correlation was 0.20. By revisiting the figure of concentric circles this review generally follows the pattern that less convergent validity occurs the further away the instrument is from the center of the circle.

In a second paper by Tudor-Locke et al. (2004) construct validity of pedometers were compared to age, anthropometric measurements and fitness measures. Construct validity was defined as “the extent to which the measurement corresponds to theoretical concepts (constructs) concerning the phenomenon under study.” For this study the authors hypothesized that an association exists with pedometer-determined activity and expected directions of fitness measures, age and anthropometric measurement. They cautioned however that strong association would not exist as physical activity is only one of many factors that influence fitness levels and body composition. The review produced 29 articles that met the criteria for evaluation. The magnitude of the correlation was determined using Cohen’s recommendations where 0.5 is large, 0.3 is moderate, and 0.1 is small. With respect to age pedometer-determined physical activity was inversely associated with a median r value of -0.21. Anthropometric measurements, specifically BMI, percentage body fat and body weight were also inversely related with median r values reported as -0.27, -0.22 and -0.16 respectively. Fitness measures based on steps/day and a 6-min walk test, timed treadmill test and a VO_2 max test revealed median correlation coefficients of 0.69, 0.41 and 0.22 respectively. The authors concluded that

the summed evidence from the reviewed studies provides support for the construct validity of pedometers in regards to age, fitness and anthropometric measures.

Synthesis of Pedometry

This review of the literature regarding the validity and reliability of pedometers for adults has produced some convincing evidence that indeed pedometers are a valid and reliable instrument for measuring physical activity behavior provided that activity is primarily walking. With that being said the researcher must exercise caution when using this or any instrument to measure physical activity behavior because no “gold standard” exists for every population and circumstance. The instrument of choice should be the one that best demonstrates the ability to accurately answer the research question.

In the articles reviewed the reliability, often expressed as intraclass correlation coefficients, ranged from 0.57 to 0.99 indicating moderate to strong reliability. The validity of the pedometers assessed varied according to the outcome measure. When pedometers were measured against accelerometers and the outcome consisted of number of steps the correlation was high but as the criterion measure changed from number of steps to measures of observation, calorimetry, recall, energy expenditure, distance traveled and VO_2 max the correlation became less impressive. This indicates that if number of steps as an indicator of physical activity behavior is what the investigator wants to measure then pedometers are a valid and reliable choice. When attempting to extrapolate energy expenditure or other measures the researcher should investigate other more appropriate measures. A common analysis by most of the articles reviewed indicates that pedometers often fail to record vertical movement at slower speeds

specifically a person moving a 2 mph or less. While this may be a limitation in frail older adults the normal gait cycle for a sedentary but otherwise healthy adult was reported to range between 3 and 4 mph. None of the articles made mention of this but for elderly adults might a shoe mounted pedometer record with more accuracy? The trade off with creating a more sensitive pedometer however is with more sensitivity the instrument may detect movement unassociated with ambulation creating an overestimation of number of steps taken thus producing more error.

Another area of concern with pedometer use in adults is when the instrument is used with obese individuals. Although only one study was mentioned by the Tudor-Locke et al. (2002) convergent validity review, the magnitude of measurement error had a positive correlation of 0.79 with BMI. It was concluded that the additional body fat may be protecting or cushioning the instrument from the vertical force thus underestimating number of steps taken. This is an important finding because this is the population researchers seem to have the most difficulty in reaching for interventions and not being able to use this simple, inexpensive and motivating measurement device with the obese population is disappointing. In addition pedometers fail to measure the intensity of activity or the amount of time spent during varying intensity levels (i.e. moderate and vigorous). This would be a problem if the researcher was specifically interested in those measures.

The analysis by Tudor-Locke and Basset (2004) which attempted to develop some standard for recommended daily steps per day rather is encouraging. Most importantly they determined that increasing a person's number of steps by as little as 2,500 per day

could have a profound impact on their health over time. This may be a reasonable and attainable goal for individuals rather than using the 10,000 steps per day as the standard. This scenario equates to the sedentary person attempting to achieve ACSM guidelines of 30 minutes of moderate intensity activity most days of the week. The sedentary person already knows they will probably fail to achieve this goal in the short term and thus in their minds have already failed. Even with the limitations presented in this synthesis it is suggested that pedometers are a valid and reliable instrument for the measurement of physical activity behavior especially when the outcome variable is number of steps taken.

Accelerometry

The use of an accelerometer as a measurement tool for assessing physical activity has gained popularity in field-based research. These devices are often small, unobtrusive and have the capacity to store sizeable amounts of data for multiple days. This data can then be downloaded to a computer where information about the frequency, intensity and duration of the activity can be determined along with an estimation of energy expenditure. Although considerably more expensive than pedometers or self-report accelerometers may provide researchers with more accurate and useable information. In recent years, technology for accelerometers has advanced from these devices measuring acceleration in one plane (uniaxial) to measuring in three planes (triaxial) and currently to omni-directional which purports to measure activity in all planes of motion. This review of the literature presents the validity and reliability of various accelerometers, discusses estimated energy expenditure issues, examines the cut-points that predict intensity and

time spent in physical activity and identifies what methods are employed for missing data.

Establishing the reliability of an instrument is paramount in supporting the validity of the particular measurement device in question. According to Welk et al. (2004) very little was known about the reliability of accelerometers therefore the reliability of four devices (Tritrac, CSA/MTI, Biotrainer, and Actical) were examined for a structured bout of physical activity over a two-year period in a sample of 38 college students. The procedures involved participants performing three bouts of treadmill walking at 3 mph for five minutes each with one of the four accelerometers secured to the right hip. A coefficient of variation (CV) was used to assess the variability across accelerometers. Generalizability (G) was employed to further flush out the total variability with the accelerometer data. The results indicate that the CV values for the Tritrac, Biotrainer Pro, CSA/MTI, and Actical were 15.9%, 18.1%, 20.1%, and 31.1% respectively. This range for the same workload indicates the counts between monitors can vary from 16% to 31% within the same individual. The generalizability results suggest that the subject accounts for the largest source of variance (50%). The intraclass correlation coefficients produced provide an overall measure of reliability with the CSA/MTI reporting 0.80 followed by the Tritrac at 0.73, the Biotrainer at 0.68 and the Actical at 0.62. The authors suggested that the individual variability across trials may possibly be due to anthropometric variations, clothing or posture. The authors were most troubled with the poor reliability demonstrated by the Actical but cautioned more testing is needed before any conclusions should be made about its accuracy.

With recreational and lifestyle activities falling into the category of moderate intensity (MET value between 3 – 6) and those activities having the ability to impact health status Hendelman et al. (2000) sought to examine the validity of accelerometry for assessing energy expenditure in free-living activities that included: walking, housecleaning, yard work and golf. Twenty-five subjects completed three test sessions described as: walking at four self-selected speeds (leisure, comfortable, moderate, and brisk) for 5-min each with a 5-min rest between bouts; playing two holes of golf while walking with a pull cart; and performing indoor/outdoor household tasks. During the tasks a TEEM100 portable metabolic measurement system was worn along with a CSA and Tritrac accelerometer and a Digiwalker pedometer. For the walking only sessions the correlation between accelerometer output and metabolic cost were 0.77 for the CSA and 0.89 for the Tritrac. When combining all activities the correlation for the CSA = 0.59 and for the Tritrac = 0.62. Between the CSA and Tritrac accelerometers the correlations were high at 0.87 and 0.93 respectively. The results further indicate that an underestimation of the intensity of each activity occurred for the CSA and Tritrac ranging from 30.5 – 56.8%. The authors concluded that when comparing these results to the Compendium of Physical Activities many household tasks may fall into the category of moderate intensity however occur often at the lower end of the spectrum thus having less impact on overall health. It was also suggested that accelerometers lack the ability to capture energy expenditure when the activity involves upper body movement, different terrain or when carrying an object. Accurately estimating energy expenditure in free-living activity remains a difficult task as evidenced by this study.

In a follow-up analysis from establishing the accuracy of four methods that measure physical activity and related energy expenditure in 13 healthy women Leenders et al. (2006) sought to determine the accuracy of regression equations converting counts with the Tritrac and ACT accelerometers into energy expenditure and comparing those results with double labeled water (DLW). The protocol for this study is described in the previous section of this review. For determining the relationships among the Tritrac and ACT regression equations and DLW a Pearson product-moment correlation was used. To calculate the agreement between DLW and the Tritrac and ACT equations a concordance correlation coefficient was generated. Five Tritrac regression equations produced significant correlations ranging from 0.51 to 0.67. The concordance coefficients were lower than what the authors stated as an accepted threshold for good concordance of 0.75 ranging from 0.04 to 0.46. Total daily energy expenditure was both underestimated (-8% to -23%) and overestimated (+12 to +101%) from the various regression equations. For the ACT accelerometer regression equations similar results were found with the range of difference between DLW-TDEE and TDEE reported as -24 to +23%. The Pearson correlation coefficients ranged from 0.41 to 0.67 and the concordance values ranged from 0.11 to 0.50 again below the 0.75 threshold. The authors concluded that challenges remain in estimating total daily energy expenditure in free-living conditions however the regression equations established by Hendelman and Swartz for the ACT accelerometer may predict better than others.

In 2006 Crouter et al. compared the Actigraph, Actical, and AMP-331 accelerometers with indirect calorimetry during sedentary, light, moderate and vigorous

activities in 48 apparently healthy adults and investigated the devices ability to predict time spent at those varying activity intensities. The Actigraph and Actical accelerometers were hip mounted where as the AMP-331 is ankle mounted and estimates steps, distance, speed and energy expenditure. The subjects participated in one of three lifestyle/sporting routines while simultaneously wearing the Cosmed K4b² to estimate oxygen consumption and the three accelerometers. Multivariate analysis was conducted to compare MET values for each activity and to detect differences between the Cosmed K4b² and each regression formula for the accelerometers. The authors reported that there are 15 regression equations for the Actigraph, two for the Actical and one for the AMP-331. The results indicated that the AMP-331 showed a close estimate of energy expenditure during walking but overestimated sedentary/light activities and underestimated moderate/vigorous activities. Similarly the Actigraph and Actical regression equations underestimated moderate/vigorous activities and overestimated sedentary/light activities. The authors concluded that no single regression equation exists to accurately assess energy expenditure or the amount of time performing light, moderate and vigorous physical activity across different types of activities. It was also suggested that researchers may look to combine two or more equations and include an inactivity threshold to better estimate energy expenditure.

As follow-up to their study in 2006 Crouter et al. (2008) developed a new prediction equation for the Actical accelerometer with two regression lines: one for walking/running and one for lifestyle activities. The methods and procedures for this study are described in the previous section of this paper. For data analysis the MET

value for minutes 4 – 9 were averaged along with the average coefficient of variation and average counts per minute. Unpublished regression equations from Klippel and Heil were used to compare the two new regression equations developed. Results indicated for the walk/run trials the CV was below 13% and for the other activities was above 13%. Therefore to develop the new 2-regression model activities were classified based on being above or below this 13%. An inactivity threshold was also established to avoid overestimating sedentary activity and was determined that < 10 counts per minute would equal 1.0 MET. A correlation of 0.89 was reported for predicted METs from the new equation and measured METs. For measuring time spent in light, moderate and vigorous PA the new equation was within 2.9 minutes providing a closer estimate than the Klippel and Heil equations. For counts per minute a threshold of 5700 was proposed to separate walking and running. The authors concluded that the new model improves the prediction of METs and time spent in various intensity levels of physical activity when using the Actical.

In another comparison study of accelerometers Paul et al. (2007) investigated the Actigraph and the Actical to determine if the two brands produce different levels of physical activity; if large variances occur between devices; and determine the implications of converting the data from one brand to the other. In this study 28 men and 28 women wore the accelerometers simultaneously on the right hip with exact position being randomized for 15 days. A log-transformation was performed to promote homoscedasticity and greatly reduce variability between the devices. Results suggest that although a strong correlation ($r = 0.90$) exists between instruments the Actigraph

recorded significantly higher daily mean counts (216.2) than the Actical (188.0). The authors concluded that daily counts were comparable between the two devices provided a log-transformation is performed.

The issue of establishing cut points to determine the amount of time spent at various intensity levels of physical activity remains a challenge in accelerometry-based research. In a study by Strath et al. (2003) ten subjects were fitted with a Cosmed K4b² (the criterion measure) and an MTI accelerometer for the purposes of comparing published MTI cut points to determine time spent in resting/light, moderate and hard free-living activity over a continuous 5-6 hour period. For all of the models estimates of mean hard activity were not significantly different from the criterion measure. For measures of time spent in resting/light and moderate physical activity however all models overestimated resting/light and underestimated moderate physical activity except for the Swartz model. The Swartz formula was developed on 28 different lifestyle activities and may provide a better method for predicting time spent in various physical activity intensity levels. The authors concluded that the accelerometer regression models for the MTI presented different predictions of physical activity intensities with varying amounts of time spent in each.

As accelerometers continue to gain acceptance and are implemented in large-scale population studies the issues of data reduction, design and analysis for calibration and the imputation of missing data present further challenges for researchers. Masse et al. in 2005 presented five issues to consider when analyzing accelerometer data: identifying the wearing period, identifying minimal wear requirement for a valid day, identifying

spurious data, computing outcome variables and aggregating days of data, and extracting bouts of moderate-vigorous physical activity. From their review of the literature Masse et al. determined that very few studies reported on the above issues. Therefore the purpose of their study was to re-analyze data from the Women on the Move (WOTM) study and address these issues in data processing. The protocol for the WOTM study involved the women wearing the ActiGraph accelerometer for one week while simultaneously keeping a physical activity diary which asked the participants to record activities of at least 10 minutes in duration. Four data reduction algorithms were applied to the accelerometer data and indicated the following: wearing time ranged from 779 – 960 minutes per day; counts per minute from 285 – 309; and average MVPA per min from 17 to 22.8. From reanalyzing the data from the WOTM study the authors made several suggestions for developing standards to reduce accelerometer data. Because small interruptions are possible during activity a 1-2 minute interruption when classifying MVPA should be allowed for identification of the wearing period. For a valid day to count a minimal wear requirement should be established and might involve wearing the device during waking hours only. Including weekend and weekday days in the analysis would be important as participants may perform activity differently between those settings. The authors concluded that the need to standardize accelerometer data reduction is necessary to be able to compare results across studies.

In research done by Welk (2005) issues regarding the calibration of accelerometers were discussed. The term “calibration” refers to the conversion of raw accelerometer counts into more meaningful data. For validity (value calibration) research

two settings are commonly used: laboratory and field-based. This review by Welk indicated that laboratory studies often involve increasing speeds on a treadmill. These laboratory studies generally produce strong correlations between activity counts and energy expenditure. Reporting results from three different studies indicated R^2 values from 0.82 to 0.93. For field-based research accelerometers are often compared to self-report measures which may lack some precision or DLW which fails to capture the time of energy expenditure. Some studies utilize portable metabolic units but have consistently underestimated the energy cost of activities of daily living. Other studies have shown an overestimation of activities. Welk (2005) then focused on reliability research and presented the two most common methods to assess this. They included using a mechanical device that provides acceleration or compare outputs from two of the same units worn on opposite sides of the body simultaneously. The author concluded that positioning has minimal effect on the outputs so comfort and ease of use should have priority and that the reliability of accelerometers is less reported than validity thus indicating a need for further reliability studies. The following are suggestions by Welk (2005) for future calibration research: be certain a representative sample is obtained; assess moderators like age, body size, and body fatness; control error by reporting the coefficient of variation; make sure the device is calibrated before use; use statistical corrections for monitor variability; use activities for which accelerometers can capture them more adequately (meaning primarily locomotor activity); and lastly a mixed model approach allows for the analysis of the repeated nature of the data.

The issue of how to treat missing data for analysis when conducting research using accelerometers is important to discuss. In 2005 Catellier et al. sought to describe procedures for imputation of missing data from the TAAG trial. The key concerns for missing data in this trial stem from knowing that activity levels vary among days of the week and times of day as well as missing data from the removal of the monitor over multiple days. Therefore the amount of data available for entry varies among individuals. This paper by Catellier et al. proposed an approach where observed data would predict activity levels for when the monitor was not worn. The procedures for the TAAG trial involved 436 eighth grade girls wearing the Actigraph accelerometer for seven complete days with an epoch set at 30 seconds. Zero counts for a period of 20 minutes were deemed times when the monitor was removed and data was missing. The primary outcome of TAAG was the mean intensity-weighted MVPA per day. The moderate-intensity threshold was set at 1500 counts per 30 seconds. Results indicated that the number of hours the monitor was worn was higher on weekdays than on weekend days. Three types of missing data were described in this study. Data said to be missing completely at random (MCAR) would have the same distribution as the primary outcome. When missing data is influenced by covariates or observed activity it is termed missing at random (MAR). If the missing data results from the missing level of activity the data are not missing at random (NMAR) and thus interject more error and bias of the estimate of activity. The decision rules for the imputation of missing data defined a complete day as non-missing counts for at least 80% of a standard measurement day which was defined as the length of time in which at least 70% of the subjects wore the

monitor. Two imputation techniques, either single or multiple were employed in a simulation study using TAAG data to evaluate their effectiveness. Through manipulation data was presented as either missing for the entire day or specific segments of the day. Results showed that the imputation methods performed similarly and better on weekdays than weekends as there was a lower percent of missing data on those days. Unbiased estimates were produced for data which were MCAR as would be expected since the missing data is random. When the data was NMAR the imputation techniques could not eliminate the bias. The authors concluded that missing data imputation is never worse than deleting incomplete days therefore researchers should consider using imputation techniques.

Synthesis of Accelerometry

The accurate measurement of physical activity behavior and the various components associated with that activity including intensity, frequency, duration and type remains critical for researchers attempting to positively impact the health of populations. This review focused on the issues faced when using accelerometry to measure these components. From a reliability perspective the literature indicates more research is needed to further establish the accuracy of various accelerometers. In a study by Welk (2005) four monitors were assessed for reliability and found their ICC ranged from 0.62 to 0.80 which might be interpreted as moderate reliability. Some of the concerns gleaned from this review highlight the difficulty in accurately measuring intensity levels in free-living activities where much of a person's daily energy expenditure occurs. The correlations for these studies ranged from 0.30 to 0.67. Laboratory based validation

provided stronger correlations as expected since the intensity and mode of activity is better controlled. With the estimation of energy expenditure commonly sought as an outcome measure in physical activity research accelerometers have attempted this estimate often measured against the criterion of a metabolic measurement system or DLW. In controlled conditions the correlations were high but in the field settings often an underestimation of physical activity energy expenditure is reported usually from the accelerometer not being able to measure activities of upper body movement or non-locomotor activity like stationary cycling. Leenders et al. (2006) found regression equations applied to the Tritrac and ActiGraph produced correlations of 0.51 to 0.67 when compared to DLW. In their study they also found that total daily energy expenditure was both underestimated and overestimated. Macfarlane et al. found correlations between the Tritrac and MTI for light, moderate, and vigorous activity ranging from 0.50 to 0.77. Crouter et al. (2006) found that the Actigraph and Actical both underestimated moderate/vigorous activity and overestimated sedentary/light activity.

Another challenge for researchers is determining what cut-points should be used to establish intensity levels of activity. This review revealed that the regression equations used should be based on the design of the study specifically the population under study and that no one regression equation exists for all situations. It is left to the researcher to determine those cut-points based on existing literature about the actual monitor being used. Cut-points varied considerably between monitors. For example the MTI accelerometer had cut-points for the minimum threshold of moderate-intensity activity

ranging from 192 to 2192 counts. This variability in cut-points poses difficulty in comparing results across studies.

This review also highlighted the matter of data processing which also includes imputation of missing data. Masse et al. (2005) concluded that identifying the wearing period and minimal wear requirement for a valid day along with identifying inconsistent data, recognizing the outcome variables and extracting bouts of moderate-vigorous activity are all important concerns researchers should consider when analyzing accelerometer data. The imputation of missing data was discussed by Catellier et al. (2005) and determined that imputation is better than simply not including missing data however decision rules must be established to determine what counts as a valid day or time.

In conclusion despite the limitations discussed in this review accelerometers provide researchers with another measurement tool that may better describe physical activity patterns and provide estimates of energy expenditure. It seems the most challenging issue facing the researcher with the use of accelerometry is identifying what cut-points to use for measures of intensity. More research is needed to establish standards by which these intensity levels are determined to draw more meaningful conclusions across studies and types of accelerometers. As with any study the research question should drive the choice of measurement instrument along with factoring in the feasibility of using such an instrument. The reliability and validity of the accelerometer must be established with each particular study to provide more meaningful interpretation of the data.

Synthesis of Physical Activity Measurement

This review of the literature for physical activity measurement has provided an investigation of different tools, all which present with the ability to capture various components of physical activity. The inherent problem exists that no one measurement device stands alone as the ‘gold standard’ for assessing physical activity behavior. This could be viewed as a disadvantage however this researcher finds the freedom to explore which instrument might best assist answering a research question as an opportunity to add depth to the experience. With human behavior as diverse as it is capturing an accurate assessment of human movement or activity is a daunting task especially when we attempt to extrapolate that information to a larger population. Fortunately researchers have developed valid and reliable instruments for our purposes. The challenge is applying the correct tool or collection of instruments to aid in the researcher’s discovery.

Direct observation is a tool that allows for real-time analysis of the behavior in question and provides an analysis of the frequency, intensity, duration and type of activity performed. Recall bias is eliminated, limited equipment is needed for the assessment and the subjects are not required to alter their behavior or be fitted with a device. Much of the research using direct observation however has only been used with children making comparisons among other populations difficult. The greatest limitation involves the extended amount of time required to train the observers. In the studies reviewed reliability ranged from 0.76 to 0.99 and validity from 0.55 to 0.91. In the behavioral sciences these correlations are considered moderate to strong. Therefore, when used in the appropriate setting, with the optimal population and with extensive

training, direct observation presents as a valid and reliable instrument for measuring physical activity behavior.

Self-report or recall instruments offer the researcher a cost-effective and time efficient method for assessing physical activity behavior. When compared to total daily energy expenditure as an outcome measure the recall instruments reviewed produced moderate correlations that ranged from 0.30 to 0.61. There is however considerable variation when analyzing individual data. With that being mentioned it is necessary to re-affirm that self-report instruments are often used when assessing larger samples rather than individuals and for that purpose the correlations remain acceptable. Assessing intensity of activity was also presented as a disadvantage of recall instruments. This real effect may have a significant impact on health as the correlations for light, moderate, and vigorous activity ranged from 0.20 to 0.35, 0.15 to 0.68, and 0.10 to 0.72 respectively. It appears that sedentary individuals rate an activity as more challenging based on their current fitness level and a more fit person may underestimate a given work load. This inability to capture accurately intensity levels may be driving the correlations negatively and presents as a strong limitation of recall instruments although the Petosa 7d-PAR instrument gets us closer to a better estimate of moderate and vigorous exercise beyond daily activities. Recall instruments are cost effect, valid and reliable methods for assessing different components of physical activity behavior among larger populations where individual data is least emphasized.

Pedometry can best be described as a valid and reliable instrument when the outcome measure is number of steps taken. For this purpose the correlations remain high.

From the studies reviewed reliability of intra-class correlations ranged from 0.57 to 0.99. When pedometry is used to estimate energy expenditure, distance covered or a fitness measure like VO_2max the correlations are significantly reduced. The instruments lack sensitivity at slow speeds and among obese individuals. As mentioned previously this limitation is disappointing as often in research we are interested in tracking the physical activity of overweight/obese individuals. Pedometry offers researchers very little information regarding the intensity of the activity and when that activity occurred. This researcher sees the benefit in using pedometers as a motivational tool rather than a measure of physical activity behavior. If the research question is interested in number of steps taken as an outcome measure then pedometry may be a cost-effective, valid and reliable choice.

Of the physical activity devices reviewed accelerometry has gained more popularity with their purported ability to capture movement in multiple planes and their ability to extrapolate the frequency, intensity and time of the activity. The intra-class correlations ranged from 0.62 to 0.80 again indicating moderate to strong reliability in the behavioral sciences. When using energy expenditure as the outcome measure accelerometers behave more consistently in the laboratory setting than the field setting. This is rationalized through the control that a lab setting maintains. However, rarely in physical activity behavior research do we desire to test our subjects in artificial settings. The correlations when energy expenditure is the outcome measure ranged from 0.30 to 0.67 in the studies reviewed. Another issue for accelerometer use involves the establishment of cut-points to separate light, moderate and vigorous intensity. There

currently exists no consensus in the literature regarding cut-points and intensity. Each device has cut-points established by the manufacturer and often those determinations are un-published. When one device uses 192 counts per minute and another uses 2192 counts per minute as cut-off points for moderate activity disparity in drawing conclusions about the intensity of the activity performed is manifest. In this situation a researcher may conclude that performing 192 counts per minute is inadequate for health benefits however the activity would be classified as moderate. This could lead the participant in the study to believe that the activity they are performing is benefiting their health where in actuality very little is being achieved. Accelerometers do poses the ability to produce much data but the processing and interpretation of that data can be challenging. Accelerometers may best be utilized when describing patterns of physical activity behavior. Although valid and reliable caution should be exercised when attempting to estimate energy expenditure as each device utilizes different regression equations for the procedure.

In conclusion measurement of physical activity behavior remains a critical issue in the advancement of our research. Establishing validity and reliability is paramount and must be carried out with each particular study. The instruments should be established for each particular population under question. As stated before the research question must drive the measurement choice. It may be necessary to use multiple measurement tools to answer the research questions and we must pay close attention to what the outcome measure is in order to identify the best possible tool available; taking into account cost-

effectiveness, sample size, feasibility, obtrusiveness, inconvenience to the subject and their compliance with the device, memory skills and age appropriateness.

CHAPTER 3

METHODS

Purpose of the Study

The purpose of this study was to examine the effects of an 8-week Social Cognitive Theory based behavioral and exercise intervention designed to increase planned physical exercise among emerging adults compared to a standard care group. A Social Cognitive Theory based behavioral intervention was administered along with supervised exercise sessions. The SCT based behavioral intervention was designed to specifically target the constructs of self-efficacy, family and friend social support, self-regulation and outcome expectancy value. The supervised exercise sessions were designed to reduce body weight, improve cardiorespiratory fitness and improve upper-body muscular endurance. Evaluation was conducted to measure rates of physical activity, change in SCT construct scores, change in fitness outcomes and the mediating effects of the SCT constructs on physical activity rate. It is hypothesized that the promotion of planned regular exercise behavior among sedentary emerging adults at a point of critical life transition will provide sufficient enhancement of physiological and psychosocial traits which will support long-term adherence of planned exercise behavior.

Study Design

The experimental design for this research study was a randomized control trial pretest-posttest control group design with follow-up testing:

R	O ₁	X	O ₂	O ₃	O ₄
R	O ₅		O ₆	O ₇	O ₈

The population represented apparently healthy, previously sedentary emerging adults aged 18-30 from Canton, OH and the surrounding community who participated in an 8-week SCT-based behavioral and exercise program with two follow-up measures at 4 weeks and 8 weeks post program. Based on Social Cognitive Theory this program targeted the psychosocial constructs of exercise self-efficacy, social support, self-regulation, and outcome expectancy value as these have demonstrated consistent correlations with exercise behavior among this population as revealed in the review of literature that accompanies this dissertation. Participants were randomly assigned to either the Social Cognitive Theory based exercise group or the standard care group. This was achieved by using Microsoft Office Excel’s random number generator function. A 15-digit random number from 0 to 1 was assigned to each participant utilizing this software. The column was then sorted in descending order. With the participants randomly sorted, the top half of the column was assigned as the treatment group and the bottom half the comparison group.

Effect Size

Effect size measures expand beyond statistical significance and attempt to determine the practical significance of the results. These can be considered the actual effects of the intervention on a particular population. Statistical and practical significance are not always in agreement. Effect size differentiates between the experimental and comparison groups the degree of difference between the two. In essence, the larger the difference the greater the effect and therefore a greater likelihood

that the particular program may be adopted or changes made. Using suggestions by Cohen effect sizes in the behavioral sciences typically have the following criteria for evaluating eta-squared (η^2): 0.01 = small effect size; 0.06 = medium effect size; and 0.14 = large effect size.

Study Timeline

- Participant recruitment: December 09, 2013 – January 12 , 2014
- Baseline assessments: January 12 – 18, 2014
- 8-week intervention: January 19, 2014 – March 16, 2014
- Post-intervention assessments: March 17 – 22, 2014
- 4-week follow-up assessments: April 13 – 19, 2014
- 8-week follow-up assessments: May 11 – 17, 2014

Subject Selection and Recruitment

The target subjects for this study were those sedentary emerging adults aged 18-30 who were no longer attending high school and had not been participating in a regular planned exercise routine for the past 30 days; defined as exercising less than 30 minutes per week. Participants were actively recruited via flyers (Appendix A) posted at various merchant locations employing a high percentage of emerging adults (i.e., retail stores, restaurants, factories) and in high pedestrian traffic buildings of four local universities and one community college; a student email announcement at Malone University; and word of mouth. Exclusion criteria involved those participants who had been participating in a regular exercise program the past 30 days (defined as exercising less than 30 minutes per week); were a member of an athletic team or athletic club; were

pregnant or planned to become pregnant in the next 16 weeks; had any known contraindication to physical activity or exercise; did not meet the age requirement of 18-30; or failed to pass the Physical Activity Readiness Questionnaire (PAR-Q). Interested participants were instructed to contact the co-investigator via email or phone for additional information and determination of eligibility. Upon initial contact, the co-investigator determined the participant's eligibility by conducting a screening interview asking questions pertaining to the inclusion criteria (Appendix B). Figure 3.1 represents the flow chart of initial respondents to final sample size per group.

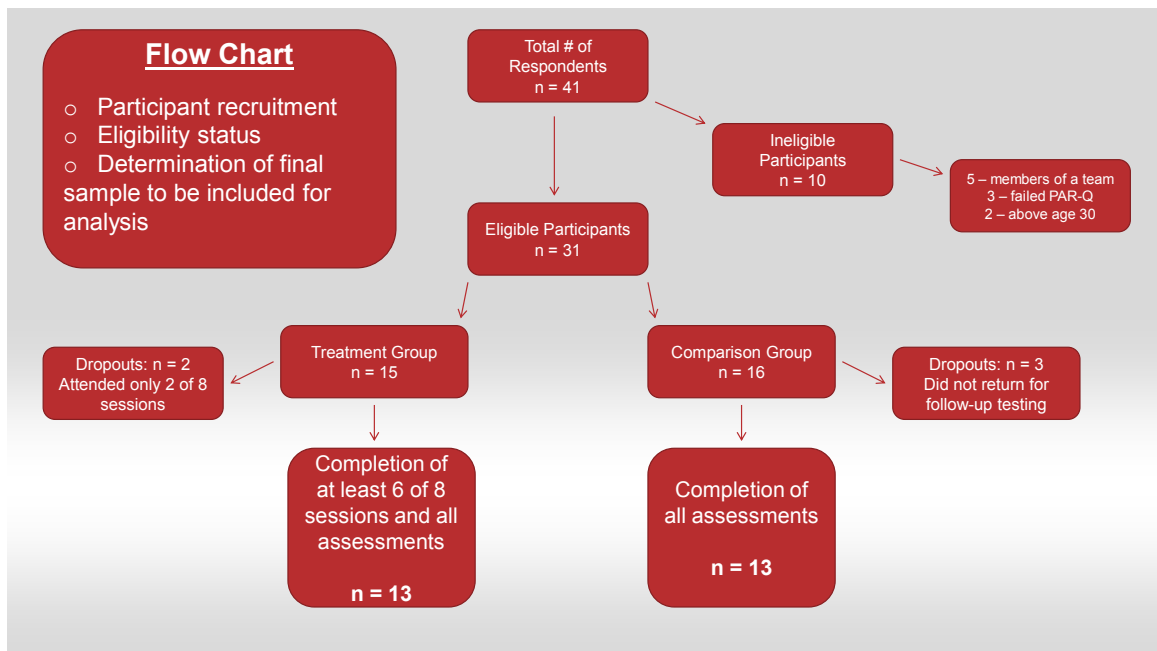


Figure 3.1. Flow chart for determining final sample size.

Intervention Description

After initial eligibility status had been determined a baseline evaluation was scheduled at which point a signed consent form and PAR-Q (Appendix C) were obtained. The eligible participants were then randomly assigned to either the treatment group or the standard care group. The treatment group participated in a transitioning program designed to enhance their capability of incorporating planned physical exercise into their everyday life within their own personal surroundings.

Treatment Group Received:

- An orientation to the Malone University Wellness Center
- Unlimited access (normal operating hours) to the Wellness Center during the 8 week intervention
- Optional body composition assessment via the BOD POD® (Life Measurement Instruments, Inc., Concord, CA)
- Fitness assessment: Rockport walk test for aerobic capacity, push-up test for upper-body muscular endurance
- Exercise prescription based on fitness testing results adhering to ACSM guidelines
- Supervised 60-minute exercise sessions in the Wellness Center starting at 3 times per week during the first week and tapering over the next 7 weeks to a transitioning out of the Wellness Center and into the participants own environment

- One 60-minute Social Cognitive Theory based behavioral strategy lesson per week for 8 weeks targeting the SCT constructs

The standard care group received what is typically offered to those individuals who join a local fitness/wellness center.

Standard Care Group Received:

- An orientation to the Malone University Wellness Center
- Unlimited access (normal operating hours) to the Wellness Center during the 8 week intervention
- Optional body composition assessment via the BOD POD® (Life Measurement Instruments, Inc., Concord, CA)
- Fitness assessment: Rockport walk test for aerobic capacity, push-up test for upper-body muscular endurance
- Exercise prescription based on fitness testing results adhering to ACSM guidelines

Measurement Protocol

The protocol for measurement involved four assessments conducted over the duration of the study (baseline-A1, post-test at 8 weeks-A2, follow-up at 12 weeks-A3, and second follow-up at 16 weeks-A4). At baseline participants completed a series of questionnaires assessing the following: (1) demographic data (gender, ethnicity, age, and university status); (2) physical activity readiness by completing the PAR-Q (revised, 2002); (3) psychosocial mediators of exercise from SCT that included exercise self-

efficacy, self-regulation, social support, and outcome expectancy value; and (4) current exercise behavior rate using the 7d-PAR questionnaire. Aerobic fitness was estimated by the 1-mile Rockport Walking test and upper body muscular endurance was assessed via the push-up test. At assessments A2 and A3 the SCT and 7d-PAR questionnaires were completed. At assessment A4 (16-weeks) participants again completed the SCT questionnaires; 7d-PAR questionnaire; and additionally the fitness measures.

Exercise Sessions

The exercise protocol for the treatment group involved an 8-week tapering program consisting of cardiovascular conditioning and resistance training exercises. The tapering was designed for the participant to understand and experience physiological and psychological response to exercise within a controlled setting and then begin to transition out of a controlled exercise setting into an exercise routine that is conducive to their unique and specific environment. During each supervised exercise session during the first eight weeks of the study participants began their workout with a 5-minute cardiovascular warm-up followed by a 25-minute total body resistance training circuit, then 25-minutes of aerobic exercise with their choice of using a treadmill, elliptical trainer, stationary bicycle, stair climber, or rower, and finishing with a 5-minute cool down incorporating flexibility exercises. During the aerobic exercise, participants wore a heart rate monitor (Polar FT4, Polar Electro Inc., NY) with the target heart rate zone set between 50% and 85% of the participants' heart rate reserve (ACSM's Guidelines for Exercise Testing and Prescription, 7th Ed.). Participants were instructed to remain in this

zone for at least 20 minutes of the aerobic exercise session. The available days/times for the tapered exercise sessions were as follows:

Weeks 1 & 2: All in Wellness Center

- Sunday 6:30 – 7:30 PM
- Tuesday 7:30 – 8:30 AM or 6:30 – 7:30 PM
- Thursday 7:30 – 8:30 AM or 6:30 – 7:30 PM

Weeks 3 & 4: Two in Wellness Center, one on their own

- Sunday 6:30 – 7:30 PM
- **ONE** session on their own not in the Wellness Center
- Thursday 7:30 – 8:30 AM or 6:30 – 7:30 PM

Weeks 5 & 6: One in Wellness Center, two on their own

- Sunday 6:30 – 7:30 PM
- **TWO** sessions on their own
 - One must be outside of the Wellness Center

Week 7: One in Wellness Center, three on their own

- Sunday 6:30 – 7:30 PM
- **THREE** sessions on their own
 - Two must be outside of Wellness Center

Week 8: One in Wellness Center, four on their own

- Sunday 6:30 – 7:30 PM
- **FOUR** sessions on their own
 - All must be outside of Wellness Center

SCT-Based Exercise Behavioral Strategy Sessions

Prior to the eight Sunday exercise sessions the treatment group participated in the SCT-based group behavioral management strategy sessions from 5:15 to 6:15 PM. These 60-minute sessions targeted those SCT constructs under investigation in this study. The focus was on developing behaviorally based approaches to increasing exercise self-efficacy, incorporating self-regulation techniques, building a social support network, and raising outcome expectancy value. Table 3.1 briefly outlines the topic and strategy that was covered during each SCT-based session.

Table 3.1: *SCT-Based Sessions*

<u>Lesson</u>	<u>Content & Targets</u>	<u>In-Class Activities</u>	<u>Homework</u>
1: Why Being Well Matters	Consciousness raising Outcome expectancy Self-regulation	-Discuss why exercise is personally important -Setting SMART exercise goals -Set weekly exercise goals	Monitor exercise
2: Health Related Components of Exercise	Consciousness raising Overcoming barriers Self-efficacy Self-regulation	-Review week 1 exercise log -List/discuss barriers to exercise -Develop strategies to overcome barriers; weekly exercise goals	-Monitor exercise -List barriers faced and strategies used to overcome
3: How Much Exercise is Enough – FITT Principle	Consciousness raising Self-efficacy Self-regulation	-Review exercise log and barriers -Monitoring exercise intensity using Karvonen method -Set weekly exercise goals	-Monitor exercise -Experience light, moderate, and vigorous exercise intensities -Level of comfort

Table 3.1 continued...

4: Who Has the Time for Exercise	Consciousness raising Self-efficacy Self-regulation	-Review exercise log -Review exercise intensity -Changing sedentary time into active time -Set weekly exercise goals	-Monitor exercise -Practice replacement of sedentary time with active time
5: Who is My Support Network	Consciousness raising Social support Self-regulation	-Review exercise log -Identify supporters and detractors of exercise -Set weekly exercise goals	-Monitor exercise -Seek out support network; track support given
6: How Can Exercise Be Fun	Consciousness raising Self-efficacy Self-regulation	-Review exercise log -Discuss alternative, fun, convenient ways to exercise -Set weekly exercise goals	-Monitor exercise -Choose and participate in 3 different venues
7: Let's Review Why Exercise is Important	Consciousness raising Outcome expectancy	-Review exercise log -Re-visit why exercise is personally important; what's changed from week 1 -Set weekly exercise goals	-Monitor exercise -Write SMART exercise goals for 1 month, 3 months, 6 months and 1 year from now
8: Bringing it all Together: Adhering to My New Lifestyle	Consciousness raising Self-efficacy Self-regulation Social support Outcome expectancy	-Review exercise log -Review/Revise <ul style="list-style-type: none"> • Long-term SMART goals • Making time • Social support network • What I value about exercising 	-Emphasis on continued monitoring -Return in 1 month for follow-up assessment

Description

These 60-minute sessions were split into thirds allowing for 20 minutes each spent in the following categories: (1) a review of the previous week and an introduction of the topic for the week using multiple pedagogical strategies that involved discussion/video/lecture; (2) in-class activities; (3) finishing with a discussion of opportunities for the upcoming week. It was during these interactive sessions that participants were to develop and enhance behavioral skills relative to the Social Cognitive Theory constructs of exercise self-efficacy, self-regulation, social support, and outcome expectancy value. Self-monitoring of exercise behavior during this program was a critical component of fostering lifelong exercise behavior and therefore was addressed in each session. This was to be achieved by the participant keeping a record of their exercise activity each week then reflecting on that exercise log during the SCT-based behavioral sessions. Each session also involved participants writing weekly exercise goals followed by a reflection and revision of those goals the next session. The participants were given a 3-ringed binder to keep all materials in and instructed to bring that binder with them to every session.

Week 1: Why Being Well Matters

This session began with an introduction, the format, and expectations of the 8-week program. A description of the benefits of exercise was presented followed by a discussion of why regular exercise might be personally important to each participant. The method of setting SMART (*Specific, Measurable, Action-*

oriented, Realistic, Time-oriented) goals was introduced and participants practiced setting exercise goals for the coming week.

Week 2: Health Related Components of Exercise

This session began with a review of the exercise log followed by a discussion on the specific health related components of exercise which included cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition. Next involved an interactive activity where participants listed and discussed their barriers to exercising regularly and then developed written strategies to overcome those barriers in the coming week. Lastly new exercise goals for the week were written.

Week 3: How Much Exercise is Enough

Each component of the FITT (frequency, intensity, time, and type) principle was introduced and discussed along with a review of the exercise log. Participants practiced the Karvonen method for determining an appropriate target heart rate range necessary to accrue health benefits from exercise. During the upcoming week participants were instructed to practice and record various intensities (light, moderate, vigorous) of exercise and determine their optimal level of comfort for exercising regularly while remaining cognizant of the FITT principle and its impact on achieving health benefits. Exercise goals for the upcoming week were written.

Week 4: Who Has Time for Exercise

This session focused on a discussion of time management techniques. A review of the previous weeks exercise log was followed by introducing and discussing the various time commitments of everyday life. Participants evaluated their own daily schedules and begin to look for opportunities where exercise can be incorporated. An emphasis on replacing sedentary time with active time was the focus for the upcoming week and new exercise goals were written.

Week 5: Who is My Support Network

A discussion of the importance of creating a positive social support network regarding healthy living and specifically exercise behavior was the main focus of this session. Participants identified supporters and detractors of exercise behavior within their personal environments and developed strategies to enlist support and positive reinforcement for future exercise behavior. After a review of their exercise logs, a list of strategies for the upcoming week was developed to enlist and track social support for continued engagement in exercise behavior. New exercise goals were also written.

Week 6: How Can Exercise be Fun

Participants listed and discussed alternative, fun, and convenient ways to exercise more. An emphasis was placed on participant's recognition of opportunities to engage in enjoyable exercise within their own community throughout the entire year; taking into account seasonal changes, likes and dislikes. The emphasis here was to focus on year-round activity in an effort to

enhance adherence rates. During the upcoming week participants were expected to try three different exercise venues and report on the enjoyment and feasibility of the activity.

Week 7: A Review of Why Exercise is Important

In this session participants re-visited their notes from the first week on why exercise is personally important to them and then discussed what perceptions had changed since week one. As a result of participants continuing to phase their exercise behavior out of the Wellness Center and into their own respective communities the next part of this session was devoted to writing SMART exercise goals for the long-term. Focusing first on goals for one month, then three months, then six months, and lastly one year participants developed structured goals over the course of the next year to encourage the maintenance of regular exercise behavior.

Week 8: Adhering to the New Lifestyle

This final session involved a review of what was covered throughout the 8-week SCT-based exercise behavior strategy sessions. Participants had an opportunity to revise their long-term SMART goals; reinforce their time management skills to include exercise behavior regularly; refine their social support network; and finally write and discuss what they value most about exercising. Participants were encouraged to continue monitoring their exercise behavior using the strategies learned in the previous sessions. Participants also schedule their post-test assessment for the following week.

Physical Exercise Behavior Measure

The assessment of physical exercise was determined by using the self-administered 7d-PAR (seven day physical activity recall) designed and validated by Petosa (1993). This instrument measures frequency of exercise in days, the intensity of exercise as moderate or vigorous, time in minutes, type of exercise performed, and whether the exercise was planned or unplanned. In a sample of adolescents this instrument demonstrated strong 1-week test-retest reliability of $r = 0.72$ for moderate exercise and $r = 0.82$ for vigorous exercise. Using seven consecutive previous day physical activity diaries the 7d-PAR demonstrated a correlation of 0.89 for moderate exercise and 0.92 for vigorous exercise.

Social Cognitive Theory Based Measures

Exercise Self-Efficacy

Exercise self-efficacy can be described as a person's perceived ability to overcome barriers to exercising regularly. The exercise self-efficacy instrument used in this study was the Self-Efficacy for Exercise Questionnaire based on recommendations by Bandura and developed by researchers from Stanford University which asks participants to rate their confidence level in exercising regularly relative to certain common barriers for the next six months on a scale from 0 – 100% (Garcia and King, 1991). A composite score is recorded by averaging the responses. Garcia and King (1991) reported high internal consistency (Cronbach's alpha = 0.90) and 12-month test-retest reliability of $r = 0.67$ along with evidence of concurrent criterion-related validity as self-efficacy predicted exercise adherence during months 1 through 6 and 7 through 12 of

their study. Wilcox et al. (2005) evaluated the same scale in a diverse population separated into three age categories represented by the following: 18 to 34 years, 35 to 54 years, and 55 and older. Internal consistencies for the subgroups were reported as high with Cronbach's alpha ranging from 0.90 to 0.94. Further analysis provided evidence for construct, criterion-related, and convergent validity across all groups as self-efficacy was significantly associated with physical activity participation.

Self-regulation

Self-regulation includes “self-monitoring of health-related behavior and the social and cognitive conditions under which one engages in it; adoption of goals to guide one's efforts and strategies for realizing them; and self-reactive influences that include enlistment of self-motivating incentives and social supports to sustain healthful practices” (Bandura, 2005, p. 246). An instrument developed by Petosa, P.S. (1993) was used to assess self-regulatory strategies for maintaining exercise behavior. This instrument asks participants to recall over the past four weeks various techniques used to help them exercise on a regular basis utilizing a 5-point Likert scale ranging from “never” to “very often.” Petosa et al. (2003) reported that content validity was established through a 2-stage review process with a panel of 5 experts; test retest reliability reported as $r = .92$; and Cronbach's alpha for internal consistency reported as 0.88.

Social Support

Social support recognizes the importance of others in shaping personal behavior and was assessed in this program using the instrument developed by Sallis et al. (1987). The scale consists of two sub-components; one for family social support and the other for

friend social support. Test-retest reliability has been established in young adult women and reported at $r = .79$ for both family and friend sub-scales (Sallis et al., 1987). Trieber et al. (1991) established validity and reliability of the instrument on a group of diverse young adults. Factor analysis supported the construct validity of the instrument and using the Baecke Physical Activity scale, predictive validity was reported at $r=.46$, $P<.001$. Cronbach's alpha for internal consistency was reported at 0.93 for the family subscale and 0.91 for the friends subscale.

Outcome expectancy value

If a person places a high value in attaining a certain goal they will be more inclined to extend the necessary effort to accomplish the task even in the presence of barriers and competing interests. Outcome expectancy value for exercise then is the importance placed on the incentives and rewards received from engaging in the behavior. An instrument developed by Steinhardt et al. (1989) was utilized to assess this social cognitive construct. This instrument has established reliability and validity. Test-retest reliability correlations ranged from 0.66 to 0.89 and internal consistency coefficients from 0.47 to 0.78 and against a 7-day recall instrument the scale predicted free-living exercise behavior with R^2 ranging from 0.12 to 0.24, $p < .05$ (Steinhardt and Dishman, 1989).

Research and Statistical Hypotheses

For this study we established research hypotheses to test the effects of our intervention on increasing the rates of planned physical exercise among our participants

and physiologic measures. We also developed hypotheses to determine the extent to which the SCT constructs changed and their ability to predict planned physical exercise.

Primary Research Hypotheses

1. Rates of moderate physical exercise behavior will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$
2. Rates of vigorous physical exercise behavior will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

Secondary Research Hypotheses

3. Self-efficacy scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$
4. Family social support scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

5. Friend social support scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

6. Outcome expectancy value scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

7. Self-regulation scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
 - d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

8. Body weight in pounds will be reduced more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
 - b. Statistical H_1 : $\mu_{A1} > \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} > \mu_{A3}$

9. Rockport walk time in minutes will be reduced more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
 - b. Statistical H_1 : $\mu_{A1} > \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} > \mu_{A3}$

10. Predicted VO_2 max in scores in ml/kg/min will increase more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.
 - a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
 - b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
 - c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$

11. The number of push-ups completed for upper body muscular endurance will increase more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.
 - a. Statistical $H_0: \mu_{A1} = \mu_{A2} = \mu_{A3}$
 - b. Statistical $H_1: \mu_{A1} < \mu_{A2}$
 - c. Statistical $H_2: \mu_{A1} < \mu_{A3}$
12. A relationship will exist between the Social Cognitive Theory construct scores and physical activity behavior for the treatment group.
13. Those Social Cognitive Theory construct variables demonstrating significance from baseline to posttest would mediate the intervention effects on follow-up physical activity rate.

Statistical Analysis

In order to examine the treatment effects on the psychosocial constructs and exercise behavior of this 8-week Social Cognitive Theory based exercise program it is necessary to establish an appropriate sample size that will provide adequate power which demonstrates a strong level of confidence in the statistical results and controls for Type II error; the failure to detect a difference when one does exist. In the behavioral sciences Cohen (1988) suggests a power of 0.80 which is the criterion for this study. Effect size or the practical significance of the study must also be considered in order to demonstrate the magnitude of difference between the treatment and control group. Cohen (1992) recommends for the behavioral sciences a low to moderate effect size of $f = 0.20$ which is the established effect size for this study. The alpha level or level of risk the researcher is willing to take that the results may occur by chance (Type I error) was set *a priori* at 0.05 which is common practice in physical activity behavior research. As we desire to reject the null hypothesis that no difference exists between the treatment and control groups in

favor of the alternative hypothesis that the SCT constructs under investigation will impact physical activity behavior, a one-tailed directional hypothesis was utilized. Considering these factors of power = 0.80, an effect size of 0.20, an alpha level set at 0.05, and the one-tailed direction of the alternative hypothesis, an appropriate sample size for this study can be estimated. Using the computer software package G* Power 3 (Faul et al., 2007) for an ANOVA repeated measures two-factor design the *a priori* computed required total sample size of 22 has been established. Statistical analysis was conducted using the software package PASW Statistics version 18.

The internal consistencies of the questionnaires were established using Cronbach's alpha. Descriptive statistics for demographic data and outcome variables are reported. An application of a two-factor mixed-effects ANOVA repeated measures design was used to examine the effects of the intervention on physical activity rates, aerobic fitness, upper body isometric strength; and the SCT constructs of exercise self-efficacy, self-regulation, social support, and outcome expectancy value. The between-group factor includes the treatment and control groups and the within-group factor involves the four measurement time points at baseline, post-test (8-weeks), 12-week follow-up from baseline, and 16-week follow-up from baseline.

To investigate the impact on physical activity behavior of the targeted psychosocial constructs that are found statistically significant from the ANOVA procedure, mediation analysis would be performed. According to Baranowski, "The mediating variable framework provides a systematic way of considering the role of theory in intervention, thereby identifying what components of our interventions are

effective and how” (1998, p. 281). MacKinnon et al. (2007) further suggest that mediation analysis checks whether the program produced the change in the targeted constructs (construct validity of the treatment); filters out program components that need strengthened; provides a check on whether targeted constructs are causally linked to the outcome; and provides evidence of how the program achieved its effects. Physical activity behavior research consistently reports a variance explained of 0.30 using current theoretical models. The causal-steps approach for mediation proposed by Baron & Kenny (1986) will be utilized: step 1, there must be established significance of the overall treatment effects; step 2, the independent variable must produce statistically significant increase in the measured mediators; step 3, the increase in mediators must produce a significant increase in the outcome variable; and step 4, when controlling for paths *a* and *b* does the previous significant direct relationship between the independent variable and dependent variable (path *c*) become reduced to zero (total mediation) or become reduced significantly (partial mediation).

Satisfaction with the Intervention

An evaluation was conducted at the conclusion of the program (week 8) to assess what components of the program the participants felt were most beneficial. A 20-item questionnaire using a 5-point Likert scale ranging from “1” (*strongly disagree*) to “5” (*strongly agree*) was developed by the researcher. The treatment group was asked questions regarding the SCT-based exercise behavioral strategy sessions; specifically targeting the practical application of the SCT constructs under study. Treatment group participants were also asked to provide feedback on what aspects of the program worked

well, how the program could be improved and any additional comments they wished to share about the intervention. The standard care group did not receive the questionnaire as they did not participate in the supervised exercise sessions or behavioral strategy sessions. An additional 10-item questionnaire using a 5-point Likert scale ranging from “1” (*strongly disagree*) to “5” (*strongly agree*) was developed by the researcher to assess perceived quality-of-life status. Both the treatment and standard care groups completed this questionnaire. Those who completed all the follow-up assessments were entered into a drawing to receive one of ten available Polar FTR 4 heart rate monitors.

Control for Threats to Internal Validity

“Internal validity is the basic minimum without which any experiment is uninterpretable” (*Experimental and Quasi-experimental Designs for Research*, Campbell & Stanley, pg. 5, 1963). Internal validity is concerned with determining if the treatment actually produced the outcome of the study, or did some other factor influence the results. Controlling threats to internal validity provides some assurance that the results obtained from an evaluation of an intervention can be attributed to intervention effects and not some extraneous variable. The more threats to internal validity that can be controlled through research design and other means described below, the more confidence can be placed in the results. Through the use of a comparison group in this study we are able to control for many of these threats.

The history threat occurs when events happen during the treatment other than the independent variable and can be controlled through randomization. If a major historical event occurred during the course of the intervention the randomization of the two groups

would control for this threat. This is more of a problem when intra-session history occurs in which an extraneous event happens during one treatment and not the other. Keeping a detailed log describing the events can help describe any differences. For the duration of this study no extraneous events were identified that might impact intra-session history.

Maturation threat occurs when subjects mature physically during a study or become fatigued during the treatment confounding the results. Controlling maturation in this study was achieved through randomization and using mature people to begin with of similar age. Also by minimizing the length of the study to 16 weeks the threat of maturation is minimized.

The testing threat can result from a pre-test where the subject develops test sensitization or becomes conditioned to the information and will subsequently score better on follow-up tests. Control for this threat was achieved through randomization establishing that since both groups were pre-tested they would exhibit equivalent post-test scores.

The instrumentation threat results from a change in the measurement tool, calibration, observers, or scorers. Controlling this threat was accomplished by using valid and reliable instruments designed specifically for the sample being studied and only one researcher was involved in the collection of data.

When extreme scores tend to move toward the mean on the second test, the internal validity threat of statistical regression has occurred. This has been described as the most subtle and trickiest error in research to internal validity threats and is a problem when studying groups who need the treatment the most. This threat was controlled

through randomization suggesting that both the treatment and control groups mean differences would regress similarly.

If subjects drop out during a study (especially at different rates based on what groups they were in – differential mortality) experimental mortality is said to have occurred. This presents inequality among the groups that can be controlled through random assignment, going after the subjects to keep them included, or using approved measures for handling missing data. Through the employment of randomization and a comparison group differential mortality was controlled. Additionally criteria was established for the treatment group that in order for data to be included participants needed to have attended at least 75% (6 of 8) of the behavioral strategy sessions.

Another threat to internal validity is implementation where the person delivering the treatment might be biased. Control might be exhibited here by monitoring or evaluating the implementation process or holding the implementer constant. For this study the comparison group was offered a general introduction to the fitness facility and free access throughout the 8-week intervention with limited interaction with the primary researcher thus limiting the bias potential.

An eighth threat to internal validity is termed statistical conclusion validity and equates to low statistical power resulting from: too small of a sample, the alpha level set to low, violation of assumptions, or “fishing” for statistical significance which atrophies the alpha level and increases the risk of Type I error. A power calculation was conducted *a priori* to achieve an adequate sample size, the alpha level was set at 0.05 which is

common practice in behavioral science and appropriate statistical analysis was performed thus controlling for this threat.

Control for Threats to External Validity

External validity is concerned with to whom can the results be generalized and under what conditions. Specifically, population external validity is interested in what group of subjects are the findings true. The target population is the one the researcher wishes to generalize to and the experimentally accessible population is the one available to the researcher. Ecological external validity asks for what situations or conditions are these results true. Collectively Campbell and Stanley (1963) term these factors jeopardizing external validity as interaction effects involving the treatment and some other variable. At the outset, the independent variable needs to be described explicitly so replication can occur.

The Hawthorne effect or reactive arrangements threat exists when knowledge of participation in an experiment may alter the response of the treatment. The subjects may behave differently or are more motivated to do the right thing and offer more socially acceptable answers or behaviors. Controlling this threat involves treating all groups the same except for the independent variable.

The interaction of testing and X threat inquires about how to generalize to those who have not been pre-tested. A control of this threat would involve not pre-testing, measuring the interactions, or using the Solomon 4 design. Post-test sensitization occurs when knowledge is gained during the post-test and that is really an extension of the treatment. Performing multiple follow-up tests can help control this threat.

Measurement of the dependent variable is another threat to external validity and to control this, valid and reliable measures must be used. The interaction of time of measurement and treatment effects questions whether the same effect will occur over time. To test the durability of the treatment effects, multiple post-tests or follow-ups should be conducted.

While generalizability remains a desirable goal in behavioral science research human nature dictates that external validity is less controllable. Without complete control of the participant and the environment in which they interact the ability to generalize to the larger population is diminished. This study followed a specific pedagogical behavioral strategy developed by the researcher targeted to this specific sample. An investigation of the impact of this approach will determine the necessity to replicate what worked well in future studies. As effective strategies for increasing exercise behavior are established further generalizability will be possible.

CHAPTER 4

RESULTS

Introduction

The purpose of this study was to examine the effects of an 8-week Social Cognitive Theory based behavioral and exercise intervention designed to increase planned physical exercise among emerging adults compared to a standard care group. A Social Cognitive Theory based behavioral intervention was administered along with supervised exercise sessions. The SCT based behavioral intervention was designed to specifically target the constructs of self-efficacy, family and friend social support, self-regulation and outcome expectancy value. The supervised exercise sessions were designed to reduce body weight, improve cardiorespiratory fitness and improve upper-body muscular endurance. Evaluation was conducted to measure rates of physical activity, change in SCT construct scores, change in fitness outcomes and the mediating effects of the SCT constructs on physical activity rate. It is hypothesized that the promotion of planned regular exercise behavior among sedentary emerging adults at a point of critical life transition will provide sufficient enhancement of physiological and psychosocial traits which will support long-term adherence of planned exercise behavior.

This chapter provides descriptive statistics of the population under study followed by the results of the analysis for each research hypothesis. After the descriptive statistics of the population are presented the effects of the intervention on the primary outcome of

physical activity behavior are presented next with frequency distributions, means, standard deviations and results from the ANOVA provided. This same format of evaluation continues with the results for the Social Cognitive Theory constructs and the fitness measures. Next in the analysis is a test of the relationship between physical activity behavior rate and SCT variables via a Pearson's correlation conducted at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group for both moderate and vigorous physical activity. Further analysis was conducted using a two mixed model linear regression to assess if the social cognitive constructs (self-efficacy, family support, friend support, outcome expectancy score, and self-regulation) predicted physical activity rate.

The first two research hypotheses establish the behavioral impact of the intervention and state that moderate and vigorous physical activity will be greater for the treatment contrasted with the comparison group at all three follow-up assessments. Research hypotheses 3 through 7 established the extent to which the intervention impacted the SCT constructs. They indicate that the SCT scores will be greater for the treatment group contrasted with the comparison group at all three follow-up assessments. Research hypotheses 8 through 11 established the extent to which the intervention impacted the fitness outcomes. They indicate that the fitness measures will be greater for the treatment group contrasted with the comparison group at all three follow-up assessments. The final two research hypotheses explore the relationship between the SCT constructs and physical activity behavior.

Descriptive Statistics

There were a total of 41 interested participants who responded to the various methods for recruitment into this study. During the initial screening process ten participants were deemed ineligible. Five respondents were already participating on an athletic team/club; two were above the age of 30; and three failed to pass the PAR-Q indicating existing medical conditions; each of which were part of the exclusion criteria previously described. Thirty one participants were considered eligible for the study and randomized to one of two conditions: the treatment group which received SCT-based behavioral strategy sessions with supervised exercise sessions or the control group which received free access to the Wellness Center. The treatment group started with 15 participants and the control group with 16. Two of the participants in the treatment group only attended two of the eight behavioral strategy sessions and did not return for the follow-up assessments and therefore were not included in the data analysis per the established 75% participation rate. Three of the participants in the control group did not return for any of the follow-up assessments and therefore were not included in the data analysis. Multiple attempts were made by the researcher to contact the non-respondents for feedback as to their lack of participation but no response offered.

The final sample size included a total of 26 participants with 13 in the treatment group and 13 in the control group. Participants ranged in ages from 18 to 30, with the average participant being 22 years old ($M = 22.12$, $SD = 4.35$). Half of the participants were female while the other half were male. The majority of the participants were Caucasian (22, 85%). Employment status of the participants varied with many not being

employed (10, 39%). Sixty five percent of the participants attended a 4-year university full time while 27% were not enrolled in higher education. Table 4.1 presents frequencies and percentages for participant demographics.

Table 4.1
Frequencies and Percentages for Participant Demographics

Demographic	<i>N</i>	%
Gender		
Male (5TG, 8CG)	13	50
Female (8TG, 5CG)	13	50
Ethnicity		
African American	3	12
Asian American	1	4
Caucasian	22	85
Employment		
Unemployed	10	39
Part-time	8	31
Full-time	8	31
Student status		
Not a student	7	27
Two year school part-time	1	4
Four year school part-time	1	4
Four year school full-time	17	65

Behavioral Impact of Intervention

Two one-within one-between ANOVAs were conducted to assess if differences existed in the 7-DPAR moderate and vigorous exercise minutes by time and by group. The one-within one-between ANOVA is the appropriate analysis to conduct when the goal is to assess for significant differences in a continuous score by a nominal grouping variable when the data is matched by time (Pallant, 2010). The two continuous

dependent variables were 7-DPAR moderate and vigorous exercise minutes, with one ANOVA conducted for each dependent variable. The data were matched by time and differences between groups were examined. A total of four time points were examined: baseline, posttest, 4 week follow up and 8 week follow up. Because sphericity is known to be rejected very commonly in repeated measures ANOVAs the Greenhouse-Geisser statistic was interpreted for all ANOVAs which corrects the degrees of freedom to account for the lack of sphericity.

Research Hypothesis 1: Rates of moderate physical exercise behavior will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the first research hypothesis we were able to reject the null in favor of the alternative hypothesis. Results of the ANOVA showed a significant effect of time, $F(2, 53) = 8.87, p < .001$, partial $\eta^2 = .27$, power = .98, suggesting a large difference in the moderate minutes by time. Pairwise comparisons showed that the baseline minutes were significantly lower compared to the posttest and two follow-up assessments. No other pairwise differences were found. Results of the ANOVA also showed significant differences in moderate 7-DPAR minutes by group, $F(1, 24) = 17.56, p < .001$, partial $\eta^2 = .42$, power = .98, suggesting that a very large difference existed in moderate 7-DPAR minutes by group. Overall the treatment group had significantly more minutes compared to the control group. Finally results of the ANOVA showed a significant interaction of group and time, $F(2, 53) = 5.78, p = .004$, partial $\eta^2 = .19$, power = .88, suggesting

moderate differences between group and time occurred in the moderate 7-DPAR scores. Pairwise comparisons showed that baseline moderate 7-DPAR scores for the treatment group were significantly lower than the posttest, 4 week, and 8 week follow up scores. Pairwise comparisons did not show differences by time for the control group. Table 4.2 presents the frequency distribution of minutes of moderate exercise at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.3 presents the frequency distribution of minutes of moderate exercise at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.4 presents the means and standard deviations for moderate 7-DPAR scores by time and group. Table 4.5 presents the results of the ANOVA. Figure 4.1 presents the means for the moderate 7-DPAR scores by time and group.

Table 4.2
Frequency Distribution of Minutes of Moderate Exercise at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

Minutes	Baseline <i>f</i>	Baseline %	Posttest <i>F</i>	Posttest %	4-wk <i>F</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	7	53.9	1	7.7	1	7.7	2	15.4
30	5	38.4	2	15.4	3	23.0	3	23.0
60	1	7.7	2	15.4	2	15.4	0	0.0
90	0	0.0	3	23.0	2	15.4	0	0.0
120	0	0.0	2	15.4	0	0.0	0	0.0
150	0	0.0	2	15.4	1	7.7	2	15.4
180	0	0.0	1	7.7	2	15.4	1	7.7
210	0	0.0	0	0.0	0	0.0	2	15.4
240	0	0.0	0	0.0	0	0.0	1	7.7
270	0	0.0	0	0.0	2	15.4	0	0.0
300	0	0.0	0	0.0	0	0.0	0	0.0
330	0	0.0	0	0.0	0	0.0	1	7.7
360	0	0.0	0	0.0	0	0.0	1	7.7
N = 13		100.0	N = 13		N = 13		N = 13	

Table 4.3

Frequency Distribution of Minutes of Moderate Exercise at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

Minutes	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>F</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	9	69.2	7	53.9	9	69.2	9	69.2
30	3	23.0	2	15.4	1	7.7	1	7.7
60	1	7.8	3	23.0	2	15.4	1	7.7
90	0	0.0	0	0.0	0	0.0	1	7.7
120	0	0.0	0	0.0	1	7.7	1	7.7
150	0	0.0	1	7.7	0	0.0	0	0.0
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.4

Means and Standard Deviations for Moderate 7-DPAR Minutes by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	23.85	24.59	15.62	18.95
Posttest	102.31	53.72	36.92	46.84
Four week follow up	115.77	94.43	26.92	39.03
Eight week follow up	156.00	118.29	28.85	42.04

Table 4.5

ANOVA for Moderate 7-DPAR Minutes by Time and Group

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Partial η^2	Observed Power
Within Subjects							
Time	74127.41	2	33387.09	8.87	.001	.27	.98
Time*Group	48329.88	2	21767.85	5.78	.001	.19	.88
Error	200637.46	53	3765.31				
Between Subjects							
Group	136300.24	1	136300.24	17.56	.001	.42	.98
Error	186259.92	24	7760.83				

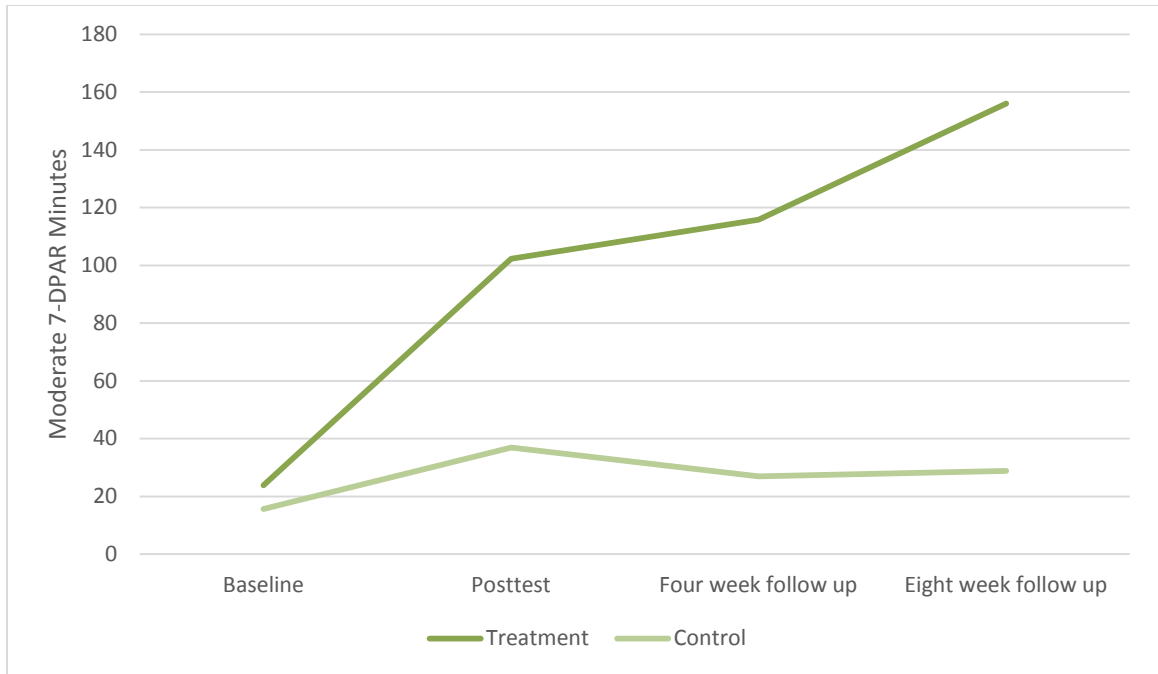


Figure 4.1. Average moderate 7-DPAR minutes by time and group.

Research Hypothesis 2: Rates of vigorous physical exercise behavior will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the second research hypothesis we failed to reject the null hypothesis. Results of the ANOVA showed no significant effect of time, $F(2, 52) = 1.54, p = .223$, partial $\eta^2 = .06$, power = .32. However, results of the ANOVA did show significant differences in vigorous 7-DPAR scores by group, $F(1, 24) = 4.52, p = .044$, partial $\eta^2 = .16$, power = .53, suggesting that a moderate difference existed in vigorous 7-DPAR scores by group, even with low statistical power which is substantial. Overall the treatment group had significantly higher scores compared to the control group. Finally results of the ANOVA

showed no significant interaction of group and time, $F(2, 52) = 0.62, p = .552$, partial $\eta^2 = .03$, power = .15. Table 4.6 presents the frequency distribution of minutes of vigorous exercise at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.7 presents the frequency distribution of minutes of vigorous exercise at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.8 presents the means and standard deviations for vigorous 7-DPAR scores by time and group. Table 4.9 presents the results of the ANOVA. Figure 4.2 presents the means for the vigorous 7-DPAR scores by time and group.

Table 4.6
Frequency Distribution of Minutes of Vigorous Exercise at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

Minutes	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	9	69.2	8	61.5	9	69.2	8	61.5
30	3	23.0	2	15.4	2	15.4	2	15.4
60	1	7.8	1	7.7	1	7.7	0	0.0
90	0	0.0	1	7.7	1	7.7	1	7.7
120	0	0.0	1	7.7	0	0.0	0	0.0
150	0	0.0	0	0.0	0	0.0	2	15.4
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.7
Frequency Distribution of Minutes of Vigorous Exercise at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

Minutes	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	11	84.6	11	84.6	13	100.0	11	84.6
30	1	7.7	1	7.7	0	0.0	2	15.4
60	1	7.7	1	7.7	0	0.0	0	0.0
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.8
Means and Standard Deviations for Vigorous 7-DPAR Minutes by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	15.38	24.28	6.92	17.97
Posttest	30.77	41.68	9.31	19.93
Four week follow up	22.85	30.38	3.08	7.51
Eight week follow up	37.92	57.87	10.77	26.60

Table 4.9
ANOVA for Vigorous 7-DPAR Minutes by Time and Group

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Partial η^2	Observed Power
Within Subjects							
Time	2954.18	2	1365.96	1.54	.212	.06	.32
Time*Group	1196.11	2	553.06	0.62	.602	.03	.15
Error	46077.96	52	887.73				
Between Subjects							
Group	9596.16	1	9596.16	4.52	.044	.16	.53
Error	50916.96	24	2121.54				

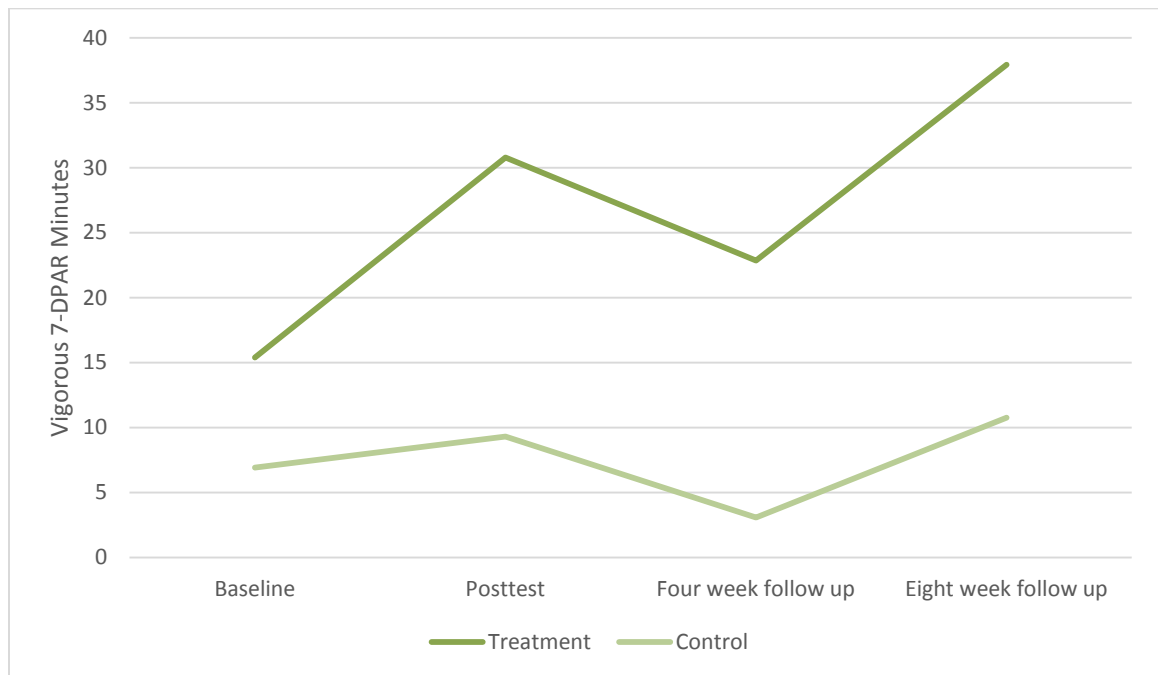


Figure 4.2. Average vigorous 7-DPAR minutes by time and group.

Impact of Intervention on SCT Constructs

The five social cognitive scores (self-efficacy, family support, friend support, outcome expectancy score, and self-regulation) were examined for differences by group and time through the use of one-within one-between ANOVAs to investigate if the intervention produced increases in scores on those measures.

Research Hypothesis 3: Self-efficacy scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the third research hypothesis we were unable to make a statistical conclusion due to reduced power of the analysis. Very low statistical power results in an inadequate test of this hypothesis. Results did show differences in self-efficacy by time, $F(2, 49) = 5.02, p = .010$, partial $\eta^2 = .17$, power = .80, suggesting moderate differences occurred in self-efficacy by time, but in the opposite direction as hypothesized. Pairwise comparisons showed that self-efficacy at 4 weeks follow up was significantly lower than self-efficacy at baseline. No other differences were found. No differences were found by group, $F(1, 24) = 0.08, p = .786$, partial $\eta^2 = .00$, power = .06, nor were they found by the interaction of group and time, $F(2, 49) = 1.16, p = .324$, partial $\eta^2 = .05$, power = .25. Table 4.10 presents the frequency distribution of self-efficacy scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.11 presents the frequency distribution of self-efficacy scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.12 presents means and standard

deviations for self-efficacy by group and time. Table 4.13 presents the results of the ANOVA. Figure 4.3 presents the average self-efficacy means by group and time.

Table 4.10
Frequency Distribution of Self-Efficacy Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

SE Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	0	0.0	0	0.0	0	0.0	0	0.0
10	0	0.0	0	0.0	0	0.0	0	0.0
20	0	0.0	0	0.0	0	0.0	1	7.7
30	0	0.0	1	7.7	0	0.0	1	7.7
40	0	0.0	0	0.0	3	23.0	1	7.7
50	0	0.0	3	23.0	2	15.5	0	0.0
60	5	38.5	4	30.8	3	23.0	2	15.4
70	3	23.0	4	30.8	3	23.0	4	30.8
80	4	30.8	1	7.7	2	15.5	3	23.0
90	1	7.7	0	0.0	0	0.0	1	7.7
100	0	0.0	0	0.0	0	0.0	0	0.0
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.11
Frequency Distribution of Self-Efficacy Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

SE Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
0	0	0.0	0	0.0	0	0.0	0	0.0
10	0	0.0	0	0.0	0	0.0	0	0.0
20	0	0.0	0	0.0	0	0.0	0	0.0
30	0	0.0	1	7.7	0	0.0	0	0.0
40	0	0.0	3	23.0	3	23.0	2	15.4
50	1	7.7	4	30.9	4	30.8	3	23.0
60	4	30.8	0	0.0	0	0.0	4	30.8
70	3	23.1	3	23.0	4	30.8	1	7.7
80	2	15.4	1	7.7	1	7.7	2	15.4
90	3	23.0	1	7.7	1	7.7	1	7.7
100	0	0.0	0	0.0	0	0.0	0	0.0
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.12

Means and Standard Deviations for Self-Efficacy Scores by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	74.72	9.25	74.44	12.18
Posttest	64.70	13.09	72.15	14.29
Four week follow up	64.87	15.55	64.68	15.40
Eight week follow up	66.89	19.09	64.97	15.80

Table 4.13

ANOVA for Self-Efficacy Scores by Group and Time

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Partial η^2	Observed Power
Within Subjects							
Time	1492.21	2	725.59	5.02	.010	.17	.80
Time*Group	343.67	2	167.11	1.16	.324	.05	.25
Error	7140.54	49	144.67				
Between Subjects							
Group	41.57	1	41.57	0.08	.786	.00	.06
Error	13292.10	24	553.84				

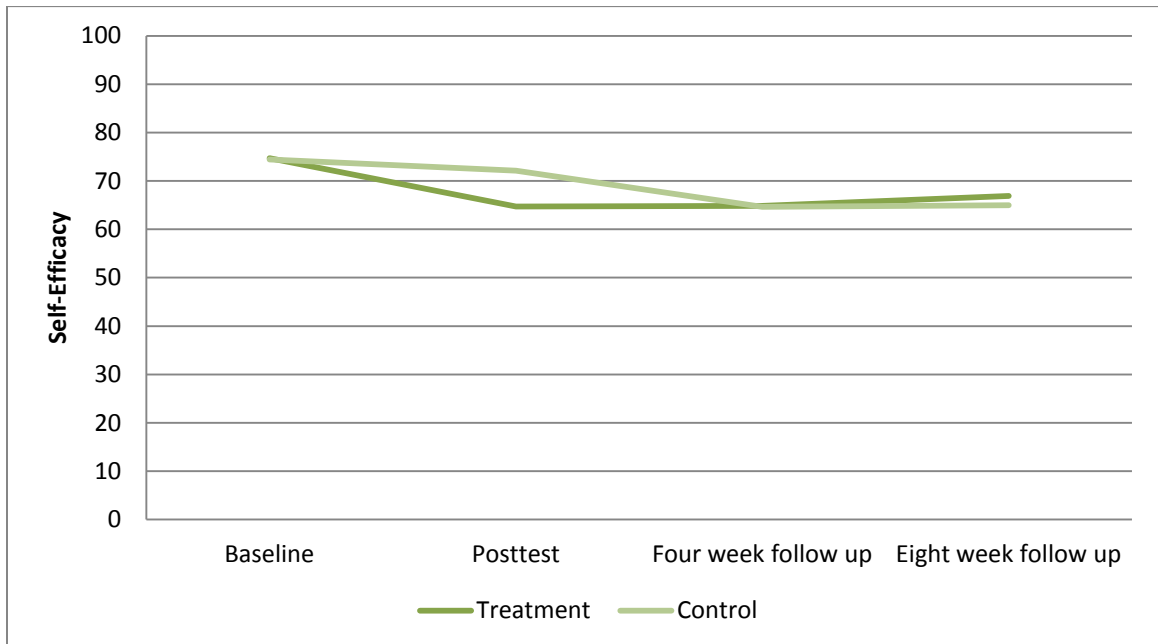


Figure 4.3. Average self-efficacy means by time and group.

Research Hypothesis 4: Family social support scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the fourth research hypothesis we were unable to make a statistical conclusion due to reduced power of the analysis. Very low statistical power results in an inadequate test of this hypothesis. Results showed no differences in family support by time, $F(2, 49) = 1.18, p = .317$, partial $\eta^2 = .05$, power = .25. No differences were found by group, $F(1, 24) = 1.52, p = .230$, partial $\eta^2 = .06$, power = .22, nor were they found by the interaction of group and time, $F(2, 49) = 1.41, p = .253$, partial $\eta^2 = .06$, power = .29. Table 4.14 presents the frequency distribution of family social support scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.15 presents the frequency distribution of family social support scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.16 presents means and standard deviations for family social support by group and time. Table 4.17 presents the results of the ANOVA. Figure 4.4 presents the average family social support means by group and time.

Table 4.14

Frequency Distribution of Family Social Support Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

Family SS Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	10	76.9	10	76.9	7	53.8	7	53.8
2	3	23.1	2	15.4	6	46.2	5	38.5
3	0	0.0	1	7.7	0	0.0	1	7.7
4	0	0.0	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.15

Frequency Distribution of Family Social Support Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

Family SS Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	10	76.9	10	76.9	10	76.9	11	84.6
2	3	23.1	3	23.1	3	23.1	2	15.4
3	0	0.0	0	0.0	0	0.0	0	0.0
4	0	0.0	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.16

Means and Standard Deviations for Family Social Support Scores by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	24.15	7.35	23.85	6.15
Posttest	25.95	9.00	22.50	7.05
Four week follow up	27.60	8.25	23.10	6.75
Eight week follow up	28.05	9.00	23.55	6.75

Table 4.17
ANOVA for Family Social Support Scores by Group and Time

Source	SS	Df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	0.29	2	0.14	1.18	.317	.05	.25
Time*Group	0.34	2	0.17	1.41	.253	.06	.29
Error	5.81	49	0.12				
Between Subjects							
Group	1.20	1	1.20	1.52	.230	.06	.22
Error	18.91	24	0.79				

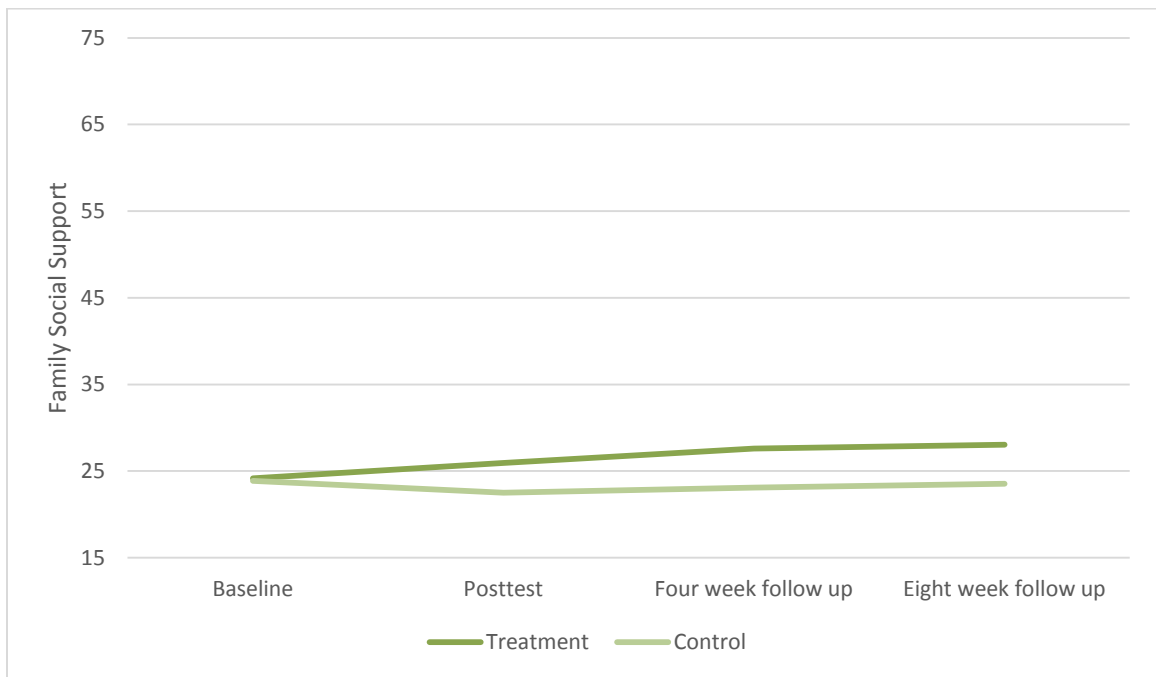


Figure 4.4. Average family social support means by group and time.

Research Hypothesis 5: Friend social support scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the fifth research hypothesis we were unable to make a statistical conclusion due to reduced power of the analysis. Very low statistical power results in an inadequate test of this hypothesis. Results showed differences in friend support by time, $F(2, 47) = 3.60, p = .036$, partial $\eta^2 = .13$, power = .64, suggesting moderate differences occurred in friend support by time. Although when pairwise comparisons were conducted no time points were different from each other. No differences were found by group, $F(1, 24) = 0.00, p = .970$, partial $\eta^2 = .00$, power = .05, nor were they found by the interaction of group and time, $F(2, 47) = 2.45, p = .098$, partial $\eta^2 = .10$, power = .47. Table 4.18 presents the frequency distribution of friend social support scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.19 presents the frequency distribution of friend social support scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.20 presents means and standard deviations for friend support by group and time. Table 4.21 presents the results of the ANOVA. Figure 4.5 presents the average friend social support means by group and time.

Table 4.18
Frequency Distribution of Friend Social Support Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

Friend SS Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	11	84.6	8	61.5	9	69.2	5	38.5
2	2	15.4	4	30.8	3	23.1	7	53.8
3	0	0.0	1	7.7	1	7.7	1	7.7
4	0	0.0	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0
	N = 13	100.0	N = 13	100.0	N = 13	100.0	N = 13	100.0

Table 4.19

Frequency Distribution of Friend Social Support Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

Friend SS Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	7	53.8	7	53.8	7	53.8	8	61.5
2	5	38.5	5	38.5	5	38.5	4	30.8
3	1	7.7	1	7.7	1	7.7	1	7.7
4	0	0.0	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.20

Means and Standard Deviations for Friend Social Support Scores by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	21.45	5.55	26.70	9.45
Posttest	29.40	10.80	27.30	9.90
Four week follow up	27.60	12.15	28.20	8.85
Eight week follow up	30.9	12.30	27.75	11.70

Table 4.21

ANOVA for Friend Social Support Scores by Group and Time

Source	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Partial η^2	Observed Power
Within Subjects							
Time	1.82	2	0.92	3.60	.036	.13	.64
Time*Group	1.23	2	0.63	2.45	.098	.09	.47
Error	12.10	47	0.26				
Between Subjects							
Group	0.00	1	0.00	0.00	.970	.00	.05
Error	33.18	24	1.38				

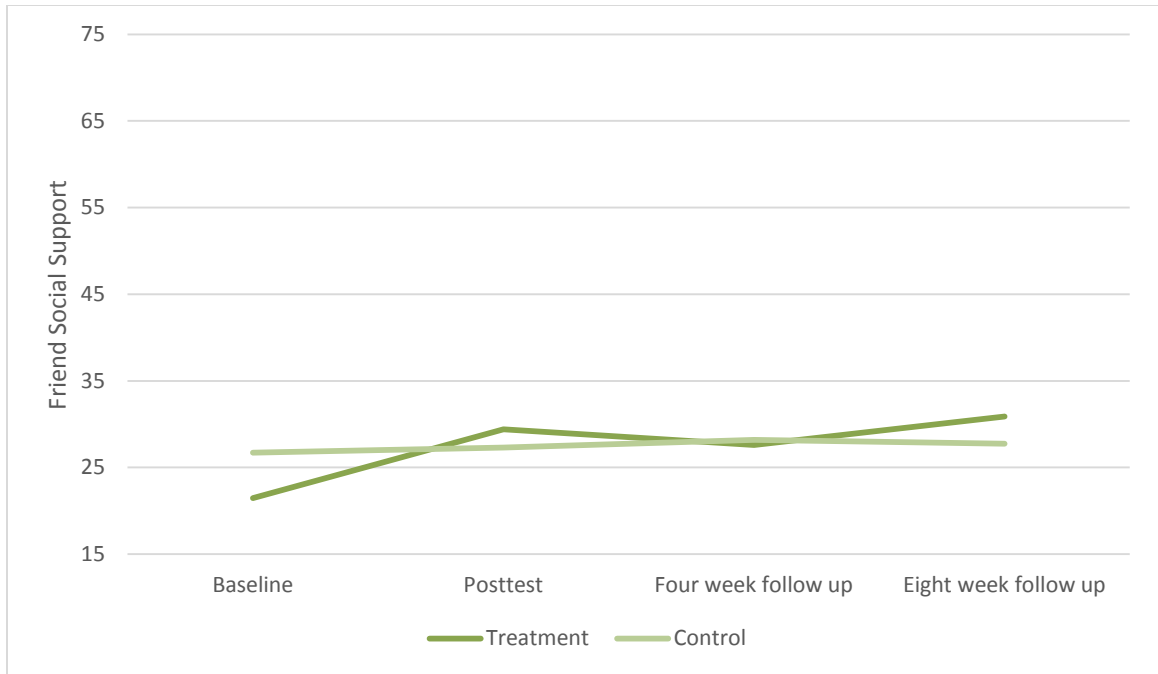


Figure 4.5. Average friend social support means by group and time.

Research Hypothesis 6: Outcome expectancy value scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the sixth research hypothesis we were unable to make a statistical conclusion due to reduced power of the analysis. Very low statistical power results in an inadequate test of this hypothesis. Results showed no differences in outcome expectancy scores by time, $F(3, 62) = 0.61, p = .591, \text{partial } \eta^2 = .03, \text{power} = .16$. No differences were found by group, $F(1, 24) = 0.11, p = .739, \text{partial } \eta^2 = .01, \text{power} = .06$, nor were they found by the interaction of group and time, $F(3, 62) = 0.93, p = .421, \text{partial } \eta^2 = .04, \text{power} = .23$. Table 4.22 presents the frequency distribution of outcome expectancy value scores at

baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group.

Table 4.23 presents the frequency distribution of outcome expectancy value scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group.

Table 4.24 presents results of the ANOVA. Table 4.25 presents means and standard deviations for outcome expectancy scores by group and time. Figure 4.6 presents the average outcome expectancy value means by group and time.

Table 4.22
Frequency Distribution of Outcome Expectancy Value Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

OEV Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	0	0.0	0	0.0	0	0.0	0	0.0
2	0	0.0	0	0.0	0	0.0	0	0.0
3	0	0.0	2	15.4	3	23.0	1	7.7
4	9	69.2	8	61.5	6	46.2	7	53.8
5	4	30.8	3	23.1	4	30.8	5	38.5
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.23
Frequency Distribution of Outcome Expectancy Value Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

OEV Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	0	0.0	0	0.0	0	0.0	0	0.0
2	0	0.0	0	0.0	0	0.0	0	0.0
3	1	7.7	4	30.8	2	15.4	2	15.4
4	8	61.5	6	46.2	7	53.8	7	53.8
5	4	30.8	3	23.0	4	30.8	4	30.8
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.24
Means and Standard Deviations for Outcome Expectancy Value Scores by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	53.40	6.90	53.88	6.12
Posttest	54.60	6.12	53.28	6.48
Four week follow up	53.04	5.88	53.16	6.00
Eight week follow up	55.20	5.04	53.28	6.48

Table 4.25
ANOVA for Outcome Expectancy Value Scores by Group and Time

Source	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Partial η^2	Observed Power
Within Subjects							
Time	0.12	3	0.05	0.61	.591	.03	.16
Time*Group	0.19	3	0.07	0.93	.421	.04	.23
Error	4.78	62	0.08				
Between Subjects							
Group	0.09	1	0.09	0.11	.739	.01	.06
Error	18.97	24	0.79				

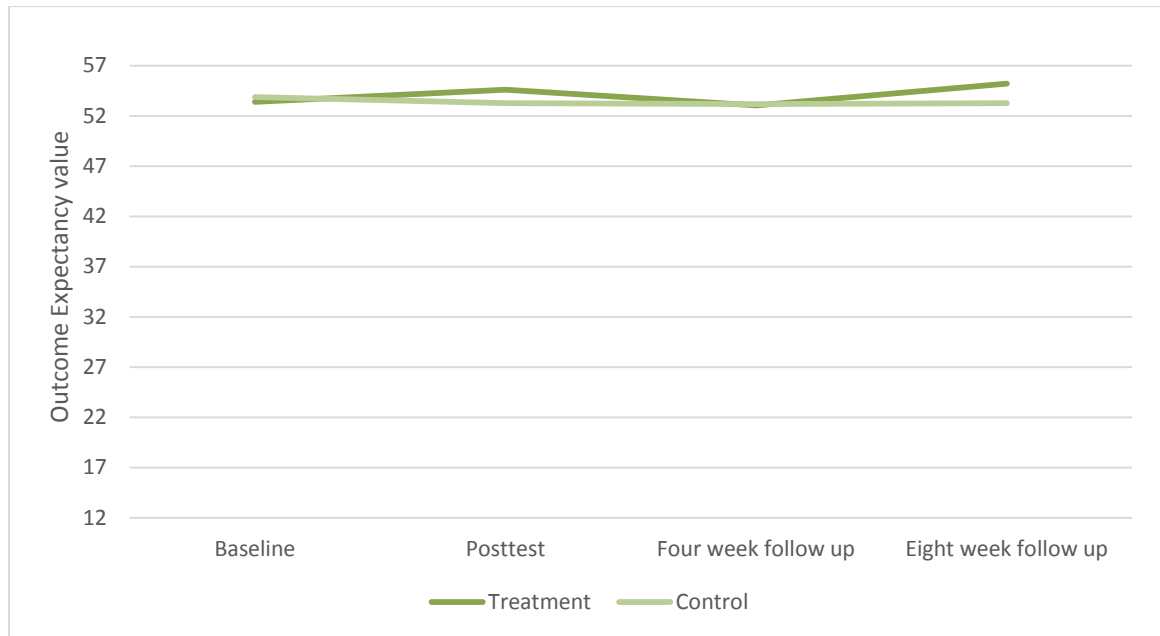


Figure 4.6. Average outcome expectancy value means by group and time.

Research Hypothesis 7: Self-regulation scores will be greater for the treatment group than the comparison group at post-test, 4-week follow-up, and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$
- d. Statistical H_3 : $\mu_{A1} < \mu_{A4}$

For the seventh research hypothesis we were unable to make a statistical conclusion due to reduced power of the analysis. Very low statistical power results in an inadequate test of this hypothesis. However, results showed differences in self-regulation by time, $F(2, 56) = 11.57, p < .001$, partial $\eta^2 = .33$, power = .99, suggesting moderate differences occurred in self-regulation by time. Pairwise comparisons found that the baseline self-regulation score was lower than all three other scores. No differences were found by group, $F(1, 24) = 2.44, p = .131$, partial $\eta^2 = .09$, power = .32. Differences were found by the interaction of group and time, $F(2, 56) = 5.09, p = .007$, partial $\eta^2 = .18$, power = .84, suggesting large differences occurred in self-regulation by group and time. Pairwise comparisons found that the baseline score was significantly lower than all three other scores for the treatment group only and no differences were found for the control group. Table 4.26 presents the frequency distribution of self-regulation scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the treatment group. Table 4.27 presents the frequency distribution of self-regulation scores at baseline, posttest, 4-week follow-up and 8-week follow-up for the comparison group. Table 4.28 presents means and standard deviations for self-regulation scores by group and time. Table 4.29 presents results of the ANOVA. Figure 4.7 presents the average self-regulation means by group and time.

Table 4.26

Frequency Distribution of Self-Regulation Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Treatment Group

SR Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	9	69.2	2	15.4	3	23.1	3	23.1
2	4	30.8	5	38.5	8	61.5	7	53.8
3	0	0.0	6	46.1	2	15.4	3	23.1
4	0	0.0	0	0.0	0	0.0	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.27

Frequency Distribution of Self-Regulation Scores at Baseline, Posttest, 4-Week Follow-up and 8-Week Follow-up for the Comparison Group

SR Score	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	4-wk <i>f</i>	4-wk %	8-wk <i>f</i>	8-wk %
1	7	53.8	4	30.8	9	69.2	7	53.8
2	5	38.5	8	61.5	3	23.1	5	38.5
3	1	7.7	1	7.7	0	0.0	0	0.0
4	0	0.0	0	0.0	1	7.7	1	7.7
5	0	0.0	0	0.0	0	0.0	0	0.0
N = 13		100.0	N = 13		100.0	N = 13		100.0

Table 4.28

Means and Standard Deviations for Self-Regulation Scores by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	74.39	23.22	79.55	33.54
Posttest	119.97	27.09	92.02	34.40
Four week follow up	105.78	27.09	79.12	41.71
Eight week follow up	106.21	30.53	83.42	43.43

Table 4.29
ANOVA for Self-Regulation Scores by Group and Time

Source	SS	Df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	5.98	2	2.56	11.57	.001	.33	.99
Time*Group	2.63	2	1.12	5.09	.007	.18	.84
Error	12.40	56	0.22				
Between Subjects							
Group	4.58	1	4.58	2.44	.131	.09	.32
Error	45.03	24	1.88				

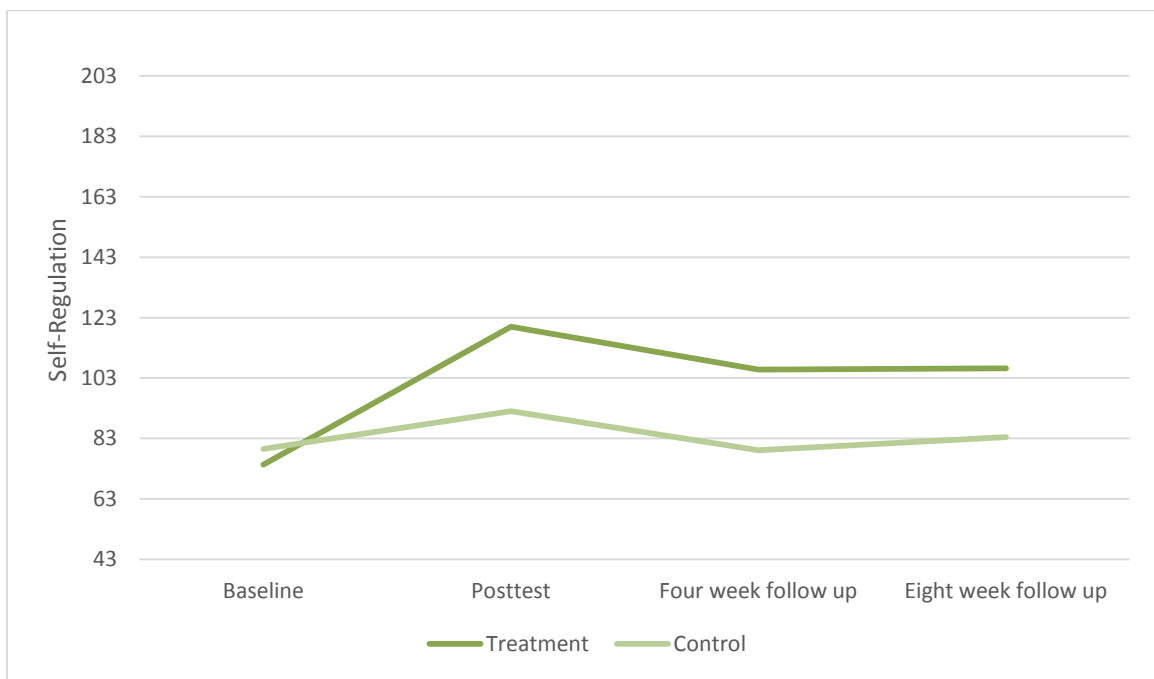


Figure 4.7. Average self-regulation means by time and group.

Impact of Intervention on Fitness Outcomes

Four one-within one-between ANOVA was conducted to examine differences in the fitness outcomes by time and group. Fitness outcomes included weight, Rockport time, VO₂max and pushups.

Research Hypothesis 8: Body weight in pounds will be reduced more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.

- d. Statistical $H_0: \mu_{A1} = \mu_{A2} = \mu_{A3}$
- e. Statistical $H_1: \mu_{A1} > \mu_{A2}$
- f. Statistical $H_2: \mu_{A1} > \mu_{A3}$

Results of the ANOVA did not show significant differences in weight by time, $F(1, 29) = 0.58, p = .485, \text{partial } \eta^2 = .02, \text{power} = .12$. The ANOVA also did not show differences by group, $F(1, 24) = 0.06, p = .814, \text{partial } \eta^2 = .00, \text{power} = .06$, although a statistical conclusion cannot be made due to reduced power for the analysis. For the eight research hypothesis we were able to reject the null in favor of the alternative hypothesis for the interaction of group and time, $F(1, 29) = 7.30, p = .008, \text{partial } \eta^2 = .23, \text{power} = .80$, suggesting large differences were found in weight by group and time. Pairwise comparisons suggested that the weight at posttest was significantly higher than the weight at 8 weeks follow-up for the treatment group only. No significant differences were found for the control group. Table 4.30 presents the frequency distribution of weight in pounds at baseline, posttest and 8-week follow-up for the treatment group. Table 4.31 presents the frequency distribution of weight in pounds at baseline, posttest and 8-week follow-up for the comparison group. Table 4.32 presents means and standard deviations for weight in pounds by group and time. Table 4.33 presents results of the ANOVA. Figure 4.8 presents the average weight in pounds by group and time.

Table 4.30
Frequency Distribution of Body Weight in Pounds at Baseline, Posttest and 8-Week Follow-up for the Treatment Group

Weight in Pounds	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
100	1	7.7	1	7.7	1	7.7
125	2	15.4	2	15.4	2	15.4
150	2	15.4	2	15.4	2	15.4
175	4	30.7	4	30.7	4	30.7
200	2	15.4	2	15.4	3	23.0
225	2	15.4	2	15.4	1	7.7
250	0	0.0	0	0.0	0	0.0
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.31
Frequency Distribution of Body Weight in Pounds at Baseline, Posttest and 8-Week Follow-up for the Comparison Group

Weight in Pounds	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
100	1	7.7	1	7.7	1	7.7
125	2	15.4	1	7.7	0	0.0
150	3	23.0	3	23.0	4	30.7
175	2	15.4	3	23.0	2	15.4
200	4	30.7	4	30.7	4	30.7
225	1	7.7	1	7.7	2	15.4
250	0	0.0	0	0.0	0	0.0
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.32
Means and Standard Deviations for Weight in pounds by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	182.68	35.91	182.49	34.14
Posttest	181.07	35.25	184.25	33.59
Eight week follow up	178.50	33.93	185.09	33.63

Table 4.33
ANOVA for Weight in Pounds by Group and Time

Source	SS	df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	11.87	1	9.74	0.58	.485	.02	.12
Time*Group	149.27	1	122.49	7.30	.008	.23	.80
Error	490.87	29	16.78				
Between Subjects							
Group	199.04	1	199.04	0.06	.814	.00	.06
Error	84800.67	24	3533.36				

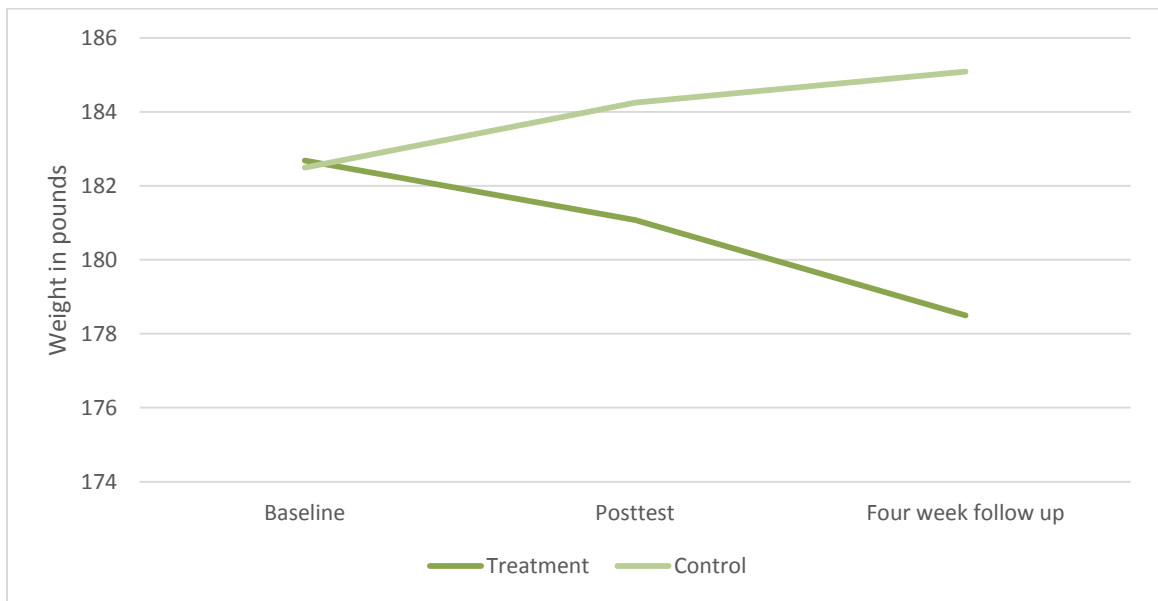


Figure 4.8. Average weight in pounds by time and group.

Research Hypothesis 9: Rockport walk time in minutes will be reduced more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
- b. Statistical H_1 : $\mu_{A1} > \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} > \mu_{A3}$

For the ninth research hypothesis we were able to reject the null in favor of the alternative hypothesis. Results of the ANOVA showed significant differences in Rockport time by time, $F(1, 26) = 10.42, p = .003$, partial $\eta^2 = .30$, power = .89, suggesting large differences in Rockport time by time. Pairwise comparisons found that baseline Rockport time was significantly higher than posttest and 8 week follow up. The ANOVA did not show differences by group, $F(1, 24) = 0.10, p = .750$, partial $\eta^2 = .00$, power = .06. Significant differences were found by the interaction of group and time, $F(1, 26) = 4.47, p = .042$, partial $\eta^2 = .16$, power = .55, suggesting moderate differences were found in Rockport time by group and time. Pairwise comparisons found that baseline Rockport time was significantly higher than both posttest and 8 week follow up times for the treatment group only. No significant differences were found for the control group. Table 4.34 presents the frequency distribution of Rockport time in minutes at baseline, posttest and 8-week follow-up for the treatment group. Table 4.35 presents the frequency distribution of Rockport time in minutes at baseline, posttest and 8-week follow-up for the comparison group. Table 4.36 presents means and standard deviations for Rockport time in minutes by group and time. Table 4.37 presents results of the ANOVA. Figure 4.9 presents the average Rockport time in minutes by group and time.

Table 4.34

Frequency Distribution of Rockport Time in Minutes at Baseline, Posttest and 8-Week Follow-up for the Treatment Group

Rockport minutes	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
10	0	0.0	0	0.0	0	0.0
12	2	15.4	4	30.7	5	38.6
14	6	46.2	7	53.9	6	46.2
16	4	30.7	2	15.4	2	15.4
18	1	7.7	0	0.0	0	0.0
20	0	0.0	0	0.0	0	0.0
22	0	0.0	0	0.0	0	0.0
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.35

Frequency Distribution of Rockport Time in Minutes at Baseline, Posttest and 8-Week Follow-up for the Comparison Group

Rockport minutes	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
10	0	0.0	0	0.0	0	0.0
12	4	30.7	4	30.7	4	30.7
14	3	23.0	5	38.6	5	38.6
16	5	38.6	4	30.7	3	15.4
18	1	7.7	0	0.0	1	7.7
20	0	0.0	0	0.0	0	0.0
22	0	0.0	0	0.0	0	0.0
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.36

Means and Standard Deviations for Rockport Time in Minutes by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	15.59	1.59	15.24	1.91
Posttest	14.60	1.15	14.95	1.70
Eight week follow up	14.52	1.13	15.08	1.75

Table 4.37

ANOVA for Rockport Time in Minutes by Group and Time

Source	SS	df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	6.88	1	6.38	10.42	.003	.30	.89
Time*Group	2.95	1	2.74	4.47	.042	.16	.55
Error	15.85	26	0.61				
Between Subjects							
Group	0.70	1	0.70	0.10	.750	.00	.06
Error	160.52	24	6.69				

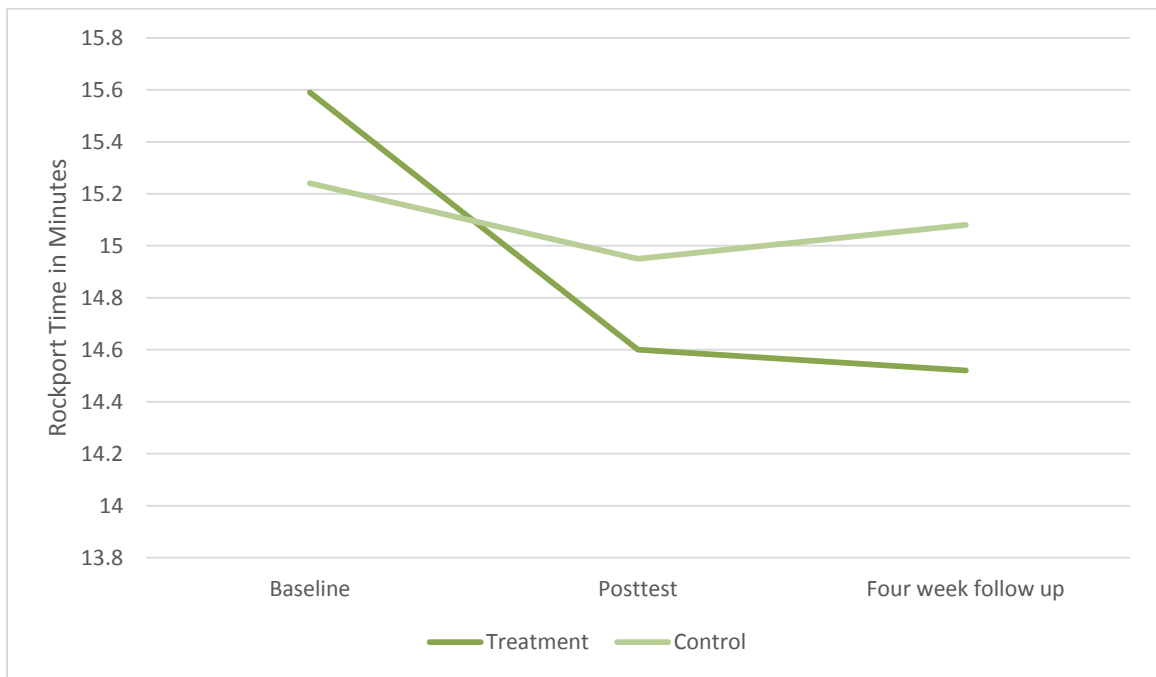


Figure 4.9. Average Rockport time in minutes by time and group.

Research Hypothesis 10: Predicted VO_2 max in scores in ml/kg/min will increase more for the treatment group than the comparison group at post-test and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$

For the tenth research hypothesis we were able to reject the null in favor of the alternative hypothesis. Results of the ANOVA showed significant differences by time, $F(1, 31) = 20.66, p < .001, \text{partial } \eta^2 = .46, \text{power} = .99$, suggesting large differences in VO_2max by time. Pairwise comparisons found that baseline VO_2max was significantly lower than posttest and 8 week follow up. The ANOVA did not show differences by group, $F(1, 24) = 0.00, p = .974, \text{partial } \eta^2 = .00, \text{power} = .05$. Significant differences were found by the interaction of group and time, $F(1, 31) = 13.82, p < .001, \text{partial } \eta^2 = .37, \text{power} = .98$, suggesting large differences were found in VO_2max by group and time. Pairwise comparisons found that as time increased the VO_2max significantly increased as well for the treatment group only. No significant differences were found for the control group. Table 4.38 presents the frequency distribution of VO_2max scores in ml/kg/min at baseline, posttest and 8-week follow-up for the treatment group. Table 4.39 presents the frequency distribution of VO_2max scores in ml/kg/min at baseline, posttest and 8-week follow-up for the comparison group. Table 4.40 presents means and standard deviations for VO_2max scores in ml/kg/min by group and time. Table 4.41 presents results of the ANOVA. Figure 4.10 presents the average VO_2max scores in ml/kg/min by group and time.

Table 4.38

Frequency Distribution of VO₂max Scores in ml/kg/min at Baseline, Posttest and 8-Week Follow-up for the Treatment Group

VO ₂ max ml/kg/min	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
20	1	7.7	0	0.0	0	0.0
25	1	7.7	2	15.4	2	15.4
30	2	15.4	1	7.7	0	0.0
35	4	30.7	1	7.7	1	7.7
40	4	30.7	6	46.2	6	46.2
45	1	7.7	2	15.4	3	23.0
50	0	0.0	1	7.7	1	7.7
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.39

Frequency Distribution of VO₂max Scores in ml/kg/min at Baseline, Posttest and 8-Week Follow-up for the Comparison Group

VO ₂ max ml/kg/min	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
20	0	0.0	0	0.0	1	7.7
25	1	7.7	1	7.7	0	0.0
30	2	15.4	1	7.7	1	7.7
35	3	23.0	4	30.8	4	30.8
40	5	38.5	4	30.8	4	30.8
45	2	15.4	2	15.4	2	23.0
50	0	0.0	1	7.7	1	7.7
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.40

Means and Standard Deviations for VO₂ Max Scores in ml/kg/min by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	36.81	6.70	39.44	6.11
Posttest	40.62	7.04	40.11	6.82
Eight week follow up	41.67	7.23	39.80	7.02

Table 4.41
ANOVA for VO₂ Max Scores in ml/kg/min by Group and Time

Source	SS	df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	103.76	1	79.9	20.66	.001	.46	.99
Time*Group	69.40	1	53.29	13.82	.001	.37	.98
Error	120.56	31	3.86				
Between Subjects							
Group	0.15	1	0.15	0.00	.974	.00	.05
Error	3238.96	24	134.96				

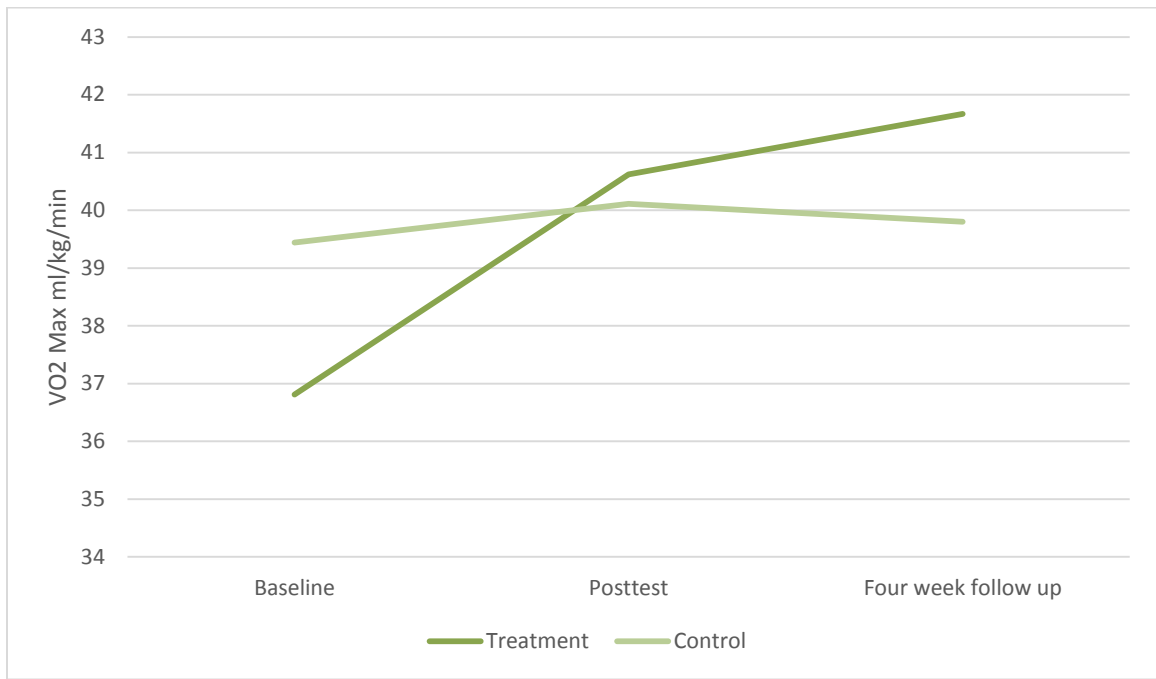


Figure 4.10. Average VO₂max in ml/kg/min by time and group.

Research Hypothesis 11: The number of push-ups completed for upper body muscular endurance will increase more for the treatment group than the comparison group at posttest and 8-week follow-up when compared to baseline values.

- a. Statistical H_0 : $\mu_{A1} = \mu_{A2} = \mu_{A3}$
- b. Statistical H_1 : $\mu_{A1} < \mu_{A2}$
- c. Statistical H_2 : $\mu_{A1} < \mu_{A3}$

For the eleventh research hypothesis we were able to reject the null in favor of the alternative hypothesis. Results of the ANOVA showed significant differences by time, $F(1, 34) = 21.39, p < .001$, partial $\eta^2 = .47$, power = .99, suggesting large differences in pushups by time. Pairwise comparisons found that baseline pushups were significantly lower than posttest and 8 week follow up. The ANOVA did not show differences by group, $F(1, 24) = 0.52, p = .477$, partial $\eta^2 = .02$, power = .11. Significant differences were found by the interaction of group and time, $F(1, 34) = 13.41, p < .001$, partial $\eta^2 = .36$, power = .98, suggesting large differences were found in pushups by group and time. Pairwise comparisons found that baseline pushups were significantly lower than posttest and 8 week follow up for the treatment group only. No significant differences were found for the control group. Table 4.42 presents the frequency distribution of total number of push-ups performed at baseline, posttest and 8-week follow-up for the treatment group. Table 4.43 presents the frequency distribution of total number of push-ups performed at baseline, posttest and 8-week follow-up for the comparison group. Table 4.44 presents means and standard deviations for total number of push-ups performed by group and time. Table 4.45 presents results of the ANOVA. Figure 4.11 presents the average total number of push-ups performed by group and time.

Table 4.42

Frequency Distribution of Total Number of Push-ups Performed at Baseline, Posttest and 8-Week Follow-up for the Treatment Group

Pushups #	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
0	3	23.1	1	7.7	1	7.7
10	3	23.1	2	15.4	1	7.7
20	3	23.1	4	30.8	5	38.5
30	3	23.1	2	15.4	2	15.4
40	0	0.0	3	23.1	3	23.0
50	1	7.6	0	0.0	0	0.0
60	0	0.0	1	7.7	1	7.7
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.43

Frequency Distribution of Total Number of Push-ups Performed at Baseline, Posttest and 8-Week Follow-up for the Comparison Group

Pushups #	Baseline <i>f</i>	Baseline %	Posttest <i>f</i>	Posttest %	8-wk <i>f</i>	8-wk %
0	1	7.7	1	7.7	0	7.7
10	3	23.1	2	15.4	4	30.8
20	5	38.5	6	46.2	6	46.2
30	3	23.1	2	15.4	1	7.7
40	1	7.7	2	15.4	2	15.4
50	0	0.0	0	0.0	0	0.0
60	0	0.0	0	0.0	0	0.0
	N = 13	100%	N = 13	100%	N = 13	100%

Table 4.44

Means and Standard Deviations for Total Number of Pushups Performed by Time and Group

Time	Treatment		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	22.46	15.52	23.38	9.85
Posttest	29.23	13.74	24.23	10.99
Eight week follow up	30.69	13.17	24.31	10.75

Table 4.45
ANOVA for Total Number of Pushups Performed by Group and Time

Source	SS	df	MS	F	p	Partial η^2	Observed Power
Within Subjects							
Time	312.33	1	220.92	21.39	.001	.47	.99
Time*Group	195.87	1	138.54	13.41	.001	.36	.98
Error	350.46	34	10.33				
Between Subjects							
Group	237.13	1	237.13	0.52	.477	.02	.11
Error	10886.00	24	453.58				

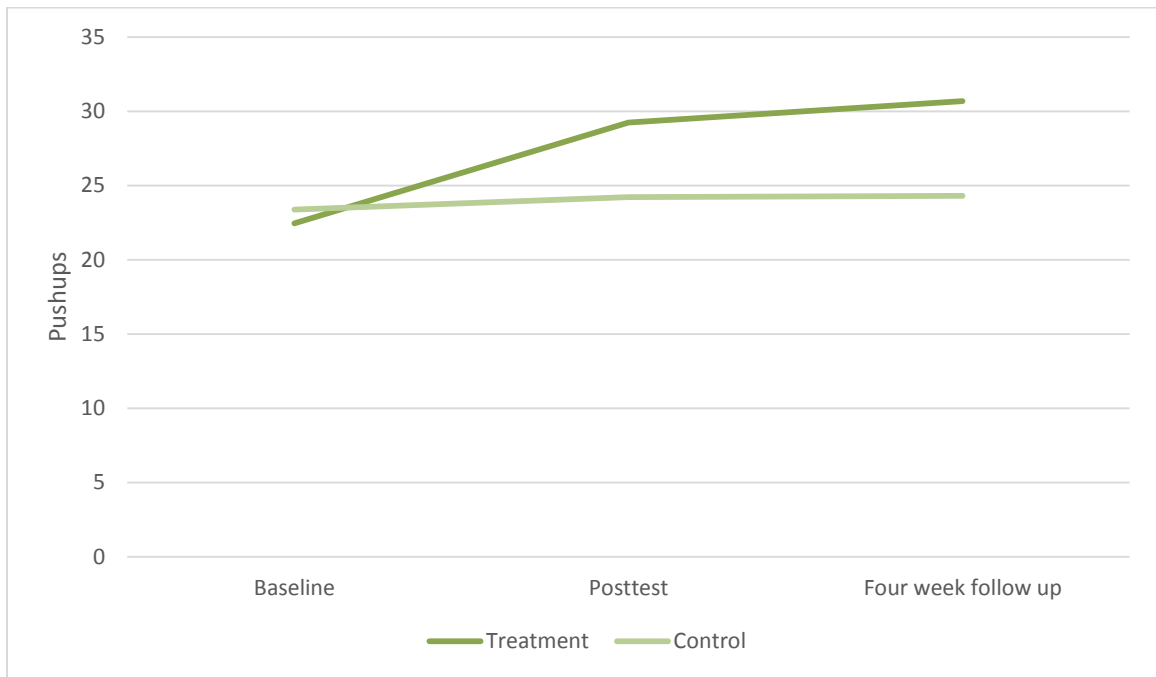


Figure 4.11. Average number of pushups by time and group.

Examination of the Relationship of Social Cognitive Theory Variables and Physical Activity Behavior

Research Hypothesis 12: A relationship will exist between the Social Cognitive Theory construct scores and physical activity behavior for the treatment group.

Pearson correlation analysis between the SCT constructs and measures of physical activity was conducted to test the relationship between the variables. A bivariate correlation matrix was developed and the results are presented in Table 4.46. There are some inter-correlations among the SCT constructs as is expected. Results indicate that several significant correlations existed. Family social support at posttest ($r=0.557$, $p<0.05$) and self-regulation at baseline ($r=.554$, $p<0.05$) were associated with baseline moderate physical activity. Friend social support at baseline ($r=0.706$, $p<0.01$) and self-efficacy at posttest ($r=.565$, $p<0.05$) were associated with baseline vigorous physical activity. Outcome expectancy value at baseline ($r=.729$, $p<0.01$) was associated with posttest vigorous physical activity.

Table 4.46

Bivariate Correlation Matrix for SCT Variables and Physical Activity Behavior Rates both at Baseline and Posttest

	SE Base	SR Base	FamSS Base	FrdSS Base	OE Base	7DPAR Mod Base	7DPAR Vig Base	SE Post	SR Post	FamSS Post	FrdSS Post	OE Post	7DPAR Mod Post	7DPAR Vig Post
SE Base	1													
SR Base	.044	1												
FamSS Base	-.349	.541	1											
FrdSS Base	.208	.532	.059	1										
OE Base	.171	-.047	.331	.408	1									
7DPAR Mod Base	-.193	.534	.422	.239	-.192	1								
7DPAR Vig Base	.284	.534	.032	.706**	.300	.280	1							
SE Post	-.003	.289	.102	.305	.170	.465	.565*	1						
SR Post	-.188	-.101	.082	.160	.305	.171	.230	.620*	1					
FamSS Post	-.450	.057	.618*	-.058	.277	.557*	-.094	.257	.230	1				
FrdSS Post	.133	.134	.092	.368	.384	-.300	.228	.335	.459	-.237	1			
OE Post	.224	-.185	.231	.028	.568	-.212	.024	.136	.638	-.031	.552	1		
7DPAR Mod Post	-.076	.554*	.532	.322	.392	-.009	.081	.114	.189	.053	.417	.300	1	
7DPAR Vig Post	-.139	.248	.494	.420	.729**	-.046	.090	.014	.153	.187	.445	.370	.726**	1

SE=self-efficacy, SR=self-regulation, FamSS=family social support, FrdSS=friend social support, OE=outcome expectancy
 Note: n = 13, *p < 0.05, **p < 0.01

Examination of the Mediating Effects of the Social Cognitive Constructs that Significantly Predicted Change in Physical Activity Rate

Research Hypothesis 13: Changes in any of the significant Social Cognitive Theory construct variables from baseline to posttest would mediate the intervention effects on follow-up physical activity rate.

- a. Statistical $H_0: \mu_{A1} = \mu_{A2} = \mu_{A3} = \mu_{A4}$
- b. Statistical $H_1: \mu_{A1} \neq \mu_{A2} \neq \mu_{A3} \neq \mu_{A4}$

Analysis was conducted using a two mixed model linear regression to assess if the social cognitive constructs (self-efficacy, family support, friend support, outcome expectancy score, and self-regulation) predicted physical activity rate. The fixed effects of the model were group, time, self-efficacy, family support friend support, outcome expectancy value, and self-regulation. The dependent variables of the model were 7-DPAR moderate and vigorous scores. One mixed model was conducted per dependent

variable. The linear mixed model is an appropriate analysis to conduct when the goal is to establish the relationship between a set of variables when they are measured across time (Tabachnick & Fidell, 2012).

Moderate 7-DPAR scores were examined first. The results of the first model showed significant fixed effects for group ($p = .001$) and time ($p = .001$). As Table 4.47 shows, self-efficacy, family support, friend support, outcome expectancy value, and self-regulation had no effect on 7-DPAR moderate scores. Table 4.48 presents the results of the mixed model regression.

Table 4.47
Mixed Model Regression for Social Cognitive Scales, Group, and Time Predicting 7-DPAR Moderate Scores

Source	<i>B</i>	SE	<i>t</i>	<i>p</i>
Group (treatment)	63.83	16.35	3.90	.001
Time	17.33	5.26	3.30	.001
Self-efficacy	0.01	0.50	0.02	.982
Family support	7.03	15.37	0.46	.649
Friend support	25.41	13.05	1.95	.055
Outcome expectancy value	-23.39	15.60	-1.50	.140
Self-regulation	20.67	12.26	1.69	.095

Vigorous 7-DPAR scores were examined next. The results of the model showed significant fixed effects for friend support only ($p = .030$). The parameter estimate for friend support suggested that as friend support increased, the vigorous 7-DPAR scores also tended to increase. As Table 4.48 shows, group, time, self-efficacy, family support,

outcome expectancy value, and self-regulation had no effect on 7-DPAR vigorous scores.

Table 4.48 presents the results of the mixed model regression.

Table 4.48
Mixed Model Regression for Social Cognitive Scales, Group, and Time Predicting 7-DPAR Vigorous Scores

Source	<i>B</i>	SE	<i>t</i>	<i>p</i>
Group (treatment)	15.89	7.88	2.02	.055
Time	0.97	2.39	0.41	.685
Self-efficacy	-0.09	0.23	-0.38	.705
Family support	13.14	7.23	1.82	.074
Friend support	13.35	6.07	2.20	.030
Outcome expectancy value	8.61	7.35	1.17	.246
Self-regulation	0.01	5.67	0.00	.998

The results of the mixed model regression indicated that the Social Cognitive Theory constructs were not able to significantly predict change in physical activity rate therefore mediation analysis was not warranted.

Participant Satisfaction

Based on a 5-point Likert scale ranging from “1” (*strongly disagree*) to “5” (*strongly agree*) several themes emerged. Four questions were grouped together as ‘enjoyment’ and scored favorably (M=4.58 ± .449). The construct of self-regulation was represented by seven questions also scoring positively (M=4.59 ± 3.40). The construct self-efficacy assessed by two questions also demonstrated a positive relationship (M=3.5 ± 1.76). The dose response was also evaluated by two questions and results suggest the dose was adequate (M=4.70 ± .473). Social support was also found to be beneficial based on two questions (M=4.66 ± .479). Lastly, outcome expectancy was least

favorable based on three questions in this process evaluation ($M=2.68 \pm .432$). This evaluation indicates that overall the program was administered as intended with constructs adequately targeted. Participants also provided written feedback regarding the intervention and reinforced the benefits of the group dynamic and interactive experiences. Several suggested more information regarding nutrition although that was not the aim of this program (Appendix G). An additional 10-item questionnaire using a 5-point Likert scale ranging from “1” (*strongly disagree*) to “5” (*strongly agree*) was used to assess the intervention’s impact on perceived quality-of-life indicators. Results showed that participants in the treatment group felt more energetic, were better able to control their weight, had less stress, were more productive, felt exercising was fun and had more confidence in exercising regularly than did the control group (treatment group $M=4.37 \pm .533$; control group $M=2.21 \pm .581$; See Appendix G).

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Introduction

As the rate of physical activity declines with age an inverse relationship with obesity rate exists. According to 2006 data from the Center for Disease Control and Prevention utilizing the Behavioral Risk Factor Surveillance System, trends in the prevalence of obesity among U.S. adults aged 18 and older had increased to 34% (Ford 2011) and has remained relatively stable at 34.9% in 2011-2012 (Ogden et al., 2014). The CDC reports that in 2008 medical costs associated with obesity related diseases are estimated at \$147 billion dollars (Finkelstein et. al., 2009). This inverse relationship between physical activity and obesity rates is a recipe for economic disaster and poses serious repercussions regarding the future health and stability of nations. In an effort to combat the deleterious effects of obesity, the American College of Sports Medicine and the Centers for Disease Control and Prevention have established guidelines regarding necessary rates of physical activity for the population of adults. The most recent Position Stand by the ACSM indicates that in order to prevent weight gain 150 – 250 minutes per week of moderate intensity physical activity is necessary and for weight loss, greater than 250 minutes per week may be required coupled with moderate diet restriction (Donnelly et al., 2009). Physical activity interventions that target the emerging adult population are necessary to establish lifelong habits of exercising to improve health outcomes.

The benefits of participating regularly in physical activity with regards to quality of life have been established. The emerging adult is at a critical time point in life where health behaviors are being shaped that may last well into adulthood (Arnett, 2000). The review of college students' physical activity behaviors by Keating et al. (2005) highlights several factors pertinent to this population; one, that physical activity history impacts continued participation; two, that emerging adult populations have been neglected in research; and third that there is a lack of multiple-pronged approaches to promote physical activity behavior. This Social Cognitive Theory based exercise intervention sought to address these concerns and provide a program that would promote long-term participation in regular physical activity.

The purpose of this study was to examine the effects of an 8-week Social Cognitive Theory based behavioral and exercise intervention designed to increase planned physical exercise among emerging adults compared to a standard care group. A Social Cognitive Theory based behavioral intervention was administered along with supervised exercise sessions. The SCT based behavioral intervention was designed to specifically target the constructs of self-efficacy, family and friend social support, self-regulation and outcome expectancy value. The supervised exercise sessions were designed to reduce body weight, improve cardiorespiratory fitness and improve upper-body muscular endurance. Evaluation was conducted to measure rates of physical activity, change in SCT construct scores, change in fitness outcomes and the mediating effects of the SCT constructs on physical activity rate. It is hypothesized that the promotion of planned regular exercise behavior among sedentary emerging adults at a

point of critical life transition will provide sufficient enhancement of physiological and psychosocial traits which will support long-term adherence of planned exercise behavior.

This chapter offers a discussion of the conclusions reached for each research hypothesis based on the statistical analysis conducted. It begins with a discussion of the impact of the intervention on physical activity rate followed by the impact of the intervention on the targeted SCT constructs. The chapter continues with a discussion on the impact of the intervention on fitness outcomes and the relationship of the SCT constructs and physical activity behavior rate. The chapter ends with a discussion of the limitations of the study and then provides recommendations for future investigation.

Intervention Effects on Physical Activity Behavior Rate

Research Hypothesis 1: Discussion

Our first primary research hypothesis stated that moderate physical activity rate would increase over the duration of the intervention and follow-up measures for the treatment group more than the comparison group. We measured moderate physical activity using the 7d-PAR, a self-report instrument. Participants were instructed to record for the past seven days the type of moderate exercise they performed to enhance health and fitness; described as exercise that mildly elevates heart rate and breathing rate yet carrying on a conversation is not difficult. They were also informed that this activity must be independent of normal daily activity or work related activity. They also recorded the minutes of moderate physical activity performed and indicated whether it was planned or not. The results of the ANOVA analysis showed a significant effect of time

($p < .001$) with a large effect size in moderate scores by time ($\eta_p^2 = .27$) for the treatment group and showed significant differences in moderate 7-DPAR scores by group ($p < .001$) and large effect size ($\eta_p^2 = .42$). The interaction of group and time was also significant ($p = .004$) with a moderate effect size ($\eta_p^2 = .19$). At baseline our participants from both the treatment group and comparison were not achieving ACSM recommendations as is expected since we were recruiting previously sedentary emerging adults (TG baseline: 23.85 ± 24.59 m/w; CG baseline: 15.62 ± 18.95 m/w). As the intervention progressed the treatment group continued to increase their minutes of moderate physical activity eventually achieving ACSM recommendations at the 8-week follow-up assessment (TG posttest: 102.31 ± 53.72 m/w; 4-week follow-up: 115.77 ± 94.43 m/w; 8-week follow-up: 156 ± 118.29 m/w). The comparison group did not significantly increase their levels of PA over the course of the intervention and did not achieve ACSM guidelines of 150 minutes of moderate PA per week (CG posttest: 36.92 ± 46.84 m/w; 4-week follow-up: 26.92 ± 39.03 m/w; 8-week follow-up: 28.95 ± 42.04). These results suggest that the SCT-based intervention provided the treatment group enactive mastery experience and additional strategies to increase their levels of physical activity.

Research Hypothesis 2: Discussion

Our second primary research hypothesis stated that vigorous physical activity rate would increase over the duration of the intervention and follow-up measures for the treatment group more than the comparison group. We measured vigorous physical activity using the 7d-PAR, a self-report instrument. Participants were instructed to record

for the past seven days the type of vigorous exercise they performed to enhance health and fitness; described as exercise that produces significant increases in heart rate, breathing rate and makes it challenging to hold a conversation. They were also informed that this activity must be independent of normal daily activity or work related activity. They also recorded the minutes of vigorous physical activity performed and indicated whether it was planned or not.

For vigorous physical activity the results from the ANOVA showed no significant effect of time or interaction of group and time however did indicate significant differences by group ($p = .044$) and moderate effect size ($\eta_p^2 = .16$). Overall the treatment group had significantly higher vigorous PA scores compared to the comparison group (TG baseline: 15.38 ± 24.28 m/w; posttest: 30.77 ± 41.68 m/w; 4-week follow-up: 22.85 ± 30.38 m/w; 8-week follow-up: 37.92 ± 57.87 m/w; CG baseline: 6.92 ± 17.97 m/w; posttest: 9.31 ± 19.93 m/w; 4-week follow-up: 3.08 ± 7.51 m/w; 8-week post-test: 10.77 ± 26.60 m/w). Although significant differences were not evident for time or the interaction of group and time the treatment group did achieve higher vigorous scores versus the comparison group. During the intervention one of the behavioral strategies that the treatment group experienced involved them establishing their comfort zone of cardiovascular exercise by monitoring their heart rate during varying intensities of moderate and vigorous exercise. Most participants indicated that moderate intensities were more appealing to them which might explain why vigorous PA did not increase significantly.

Effects of the Intervention on Social Cognitive Theory Outcomes

The behavioral strategy sessions were designed to target the SCT constructs of self-efficacy, family social support, friend social support, self-regulation and outcome expectancy value. Participants were expected to attend eight 60-minute behavioral strategy sessions that included discussion and interactive activities. Each participant was given a notebook the first session and asked to keep it with them throughout each week to record exercise behavior and complete other assigned activities. Each subsequent strategy session the notebooks were reviewed and then the participants were given the current weeks' lesson to add to their notebook. This provided the participant to self-monitor their behavior throughout the intervention. Due to a reduced sample size and low statistical power we were unable to conduct an adequate statistical analysis of the Social Cognitive Theory variables, therefore caution is warranted when interpreting the results.

Research Hypothesis 3: Discussion

Self-efficacy was examined first and ANOVA results showed differences by time ($p = .010$) with a moderate effect size ($\eta_p^2 = .17$). At 4-week follow-up pairwise comparisons showed self-efficacy was lower than at baseline for both the treatment and comparison groups (TG: baseline 74.72 ± 9.25 ; 4-week follow-up 64.87 ± 15.55 ; CG: baseline 74.44 ± 12.18 ; 4-week follow-up 64.68 ± 15.40). An explanation for this finding may be that the participants underestimated the challenges with exercising regularly and therefore had an inflated baseline self-efficacy score. The realities of incorporating regular exercise behavior into the participant's daily life may have become

apparent during the course of the intervention and thus presented a more realistic assessment of self-efficacy at the follow-up measures which never rebounded to baseline levels. In future studies it may be necessary to delay the assessment of baseline self-efficacy in overcoming barriers to exercise after a time period when participants have been exposed to the real difficulties of exercising regularly.

Research Hypothesis 4: Discussion

Family support results showed no differences by time, group, or the interaction of group and time. One explanation for this might be that this group of emerging adults participating in this study had an average age of 22 and 65% were enrolled full-time in a university. These characteristics might suggest that this group is experiencing less influence from family as they are beginning to adopt more adult roles and developing a sense of semi-autonomy.

Research Hypothesis 5: Discussion

For friend support results demonstrated differences by time ($p = .036$) and a moderate effect size ($\eta_p^2 = .13$). No differences were found by group or the interaction of group and time. The treatment group increased their friend support scores from baseline (1.43 ± 0.37) to 8-week follow-up (2.06 ± 0.82). This suggests that treatment participants were seeking friend support to increase their levels of physical activity over the course of the intervention. This is plausible since a majority of the participants were away from home and surrounded by their peers.

Research Hypothesis 6: Discussion

Outcome expectancy results showed no differences by time, group, or interaction of group and time. Upon investigation of the outcome expectancy scores it should be noted that participants in both groups at baseline had a very high outcome expectancy value therefore creating a ceiling effect (TG: baseline 4.45 ± 0.46 , posttest 4.55 ± 0.51 , 4-week follow-up 4.42 ± 0.49 , 8-week follow-up 4.60 ± 0.42 ; CG: baseline 4.49 ± 0.51 , posttest 4.44 ± 0.54 , 4-week follow-up 4.43 ± 0.50 , 8-week follow-up 4.44 ± 0.54). This suggests that there was very little room for improvement regarding this construct. It is possible that participants, based on social norms and public health campaigns, are fully aware of the benefits of exercising regularly and knowingly expect certain outcomes. Achieving those outcomes however is the greater challenge.

Research Hypothesis 7: Discussion

The ANOVA results for self-regulation showed differences by time ($p < .001$) and a large effect size ($\eta_p^2 = .33$). Pairwise comparisons also found that baseline self-regulation score was lower than all three other scores specifically for the treatment group. Differences were also found by the interaction of group and time ($p = .007$) and a moderate effect size ($\eta_p^2 = .18$). These results for the treatment group's self-regulation scores suggest the intervention was able to equip the participants with strategies to self-regulate their exercise behavior in order to increase their levels of participation (TG: baseline 1.73 ± 0.54 , posttest 2.79 ± 0.63 , 4-week follow-up 2.46 ± 0.63 , 8-week follow-up 2.47 ± 0.71).

Effects of the Intervention on Fitness Outcomes

We sought to investigate the effects the intervention would have on the following fitness outcomes: weight, Rockport one-mile walk time and aerobic fitness, and upper-body muscular endurance measured via the push-up test. The 60-minute supervised exercise sessions were designed so the participants could develop mastery of exercising in a fitness center. They were given instruction on proper warm-up; were supervised and corrected on form during the resistance training; monitored their individual heart rates during aerobic exercise; and practiced stretching techniques for the cool down. The impact on fitness outcomes lends support to the increases in moderate physical activity rate reported by the treatment group.

Research Hypothesis 8: Discussion

Results of the ANOVA did not show significant differences in weight by time or group but did elicit significant differences ($p = .008$) by the interaction of group and time and demonstrated a large effect size ($\eta_p^2 = .23$). Pairwise comparisons showed that the weight at posttest was significantly lower than the weight at 8-weeks follow-up for the treatment group only (TG: baseline 182.68 ± 35.91 lbs., 8-week follow-up 178.50 ± 33.93 lbs.). Since our treatment participants were resistance training at least once per week we can surmise that the weight that was lost would most likely be fat weight.

Research Hypothesis 9: Discussion

Rockport one-mile walk time results indicated significant differences by time ($p = .003$) and a large effect size ($\eta_p^2 = .30$). Pairwise comparisons found that baseline Rockport time was significantly higher than posttest and 8-week follow-up and

significant differences were found by the interaction of group and time ($p = .042$) and moderate effect size ($\eta_p^2 = .16$) indicating a significant reduction in Rockport one-mile walk time for the treatment group (TG: baseline 15.59 ± 1.59 min, posttest 14.60 ± 1.15 min, 8-week follow-up 14.52 ± 1.13 min). No significant differences were found for the comparison group. This data suggests that the treatment group participants were able to improve their walk time over the duration of the intervention. Through the monitoring of aerobic exercise via heart rate monitors and maintaining activity within their target heart rate range the participants were able to improve their cardiovascular fitness and thus reduce their Rockport walk time.

Research Hypothesis 10: Discussion

The ANOVA results for VO_2 max showed significant differences by time ($p < .001$) and a large effect size ($\eta_p^2 = .46$). Pairwise comparisons found that baseline VO_2 max was significantly lower than posttest and 8-week follow-up and significant differences were found by the interaction of group and time ($p < .001$) and large effect size ($\eta_p^2 = .37$) indicating a significant increase in the participants VO_2 max for the treatment group (TG: baseline 36.81 ± 6.70 ml/kg/min, posttest 40.62 ± 7.04 ml/kg/min, 8-week follow-up 41.67 ± 7.23 ml/kg/min). No significant differences were found for the comparison group. The treatment group was able to increase their estimated VO_2 max over the duration of the intervention suggesting an improved cardiovascular effect.

Research Hypothesis 11: Discussion

To examine upper body muscular endurance we incorporated a standard push-up test. The ANOVA results for pushups showed significant differences by time ($p < .001$)

and a large effect size ($\eta_p^2=.47$). Pairwise comparisons found that baseline pushups were significantly lower than posttest and 8-week follow-up and significant differences were found by the interaction of group and time ($p < .001$) and large effect size ($\eta_p^2=.36$) indicating a significant increase in the number of pushups performed by the participants in the treatment group (TG: baseline 22.46 ± 15.52 , posttest 29.23 ± 13.74 , 8-week follow-up 30.69 ± 13.17). No significant differences were found for the comparison group. The treatment group was able to increase their number of pushups over the duration of the intervention suggesting an increase in upper body muscular endurance. This positive adaptation can be explained through the incorporation of resistance training exercises that were part of each supervised exercise session.

Relationship of Social Cognitive Variables and Physical Activity Behavior

Research Hypothesis 12: Discussion

Pearson correlation analysis between the SCT constructs and measures of physical activity was conducted to test the relationship between the variables. While several significant correlations were reported and the ANOVA analysis previously described demonstrated an overall increase in moderate physical activity rate and increased scores on self-regulation for the treatment group the results from the correlation should be interpreted with caution. It is possible that the reduced sample size is contributing to the inability to detect additional associations. Sample size tends to have the largest effect on actual power of the analyses. Another explanation may be that the power of analysis can be low if the effect size found in the analysis is also low. Since the relationship between

SCT variables presented as fairly small indicating a small effect it is possible we were unable to detect any differences due to this effect.

Research Hypothesis 13: Discussion

The two mixed model linear regression analysis was conducted to determine if the social cognitive constructs of self-efficacy, family and friend support, outcome expectancy, and self-regulation could predict physical activity behavior rate. For moderate physical activity the model showed significant fixed effects for group and time but failed to demonstrate any influence from the SCT constructs. With regards to vigorous physical activity the regression model did suggest that as friend social support increased over time the vigorous 7-DPAR scores also increased suggesting a linear relationship. Again it should be noted that due to a reduced sample size and low statistical power we were unable to conduct an adequate statistical analysis of the Social Cognitive Theory variables. This could be why the results from the mixed model regression indicated that the Social Cognitive Theory constructs were not able to significantly predict change in physical activity rate. Without an adequate test of the theory mediation analysis could not be conducted.

Limitations

The major limitation in this study was the inability to adequately test the hypotheses for the Social Cognitive Theory constructs due to a lack of statistical power most likely due to a reduced sample size and lowered effect sizes. Additional limitations to this study are further discussed. Anytime you have volunteers for a study they may possess different personal characteristics and motivations than those who do not volunteer. For exercise behavior studies the volunteers have reached a point where they are ready to make a change. With the person who does not volunteer we have yet to figure out what characteristics are preventing them from participation. We also sought to recruit more non-university students as this population is understudied and found they are a population that is very difficult to reach. The researcher went to great lengths personally visiting over 200 local businesses, restaurants, churches and major manufacturing companies attempting to recruit non-university students with limited results. Through random assignment in this study we were assured the participants were similar in personal and physical characteristics at baseline but once assigned to a group, their attitudes may have changed. This study could not be blinded therefore participants knew what each group was receiving during the intervention. The comparison group may have been less motivated to participate knowing they were not receiving the full treatment although they were assured they would receive all the materials the treatment group received upon completion of the intervention. Due to time and resource limitations we used a self-report questionnaire (although reliable and valid) to measure physical activity behavior. Using a more objective measure like an accelerometer might help to

more accurately capture physical activity rate. Another limitation of the study is how the tailoring of physical activity from the controlled environment to the participant's personal environment did not materialize as planned. While every effort was made by the researcher to be available for additional supervised exercise sessions, none of the treatment group participants were able to take advantage of this opportunity. Therefore the supervised exercise sessions only occurred once per week on Sunday evenings. Even with this limitation data suggests participants did increase moderate physical activity over the duration of the intervention and at both follow-up assessments. This program took place during the winter months and early spring in Northeast Ohio which may also have negatively impacted physical activity rates. Being confined to indoor activity could be a barrier to exercising regularly for those that enjoy the outdoors and is a limitation in this study. Another limitation involves the inability of the researcher to control the external environment of the participants. While the treatment group was prepared with strategies to exercise more on their own outside of the controlled environment and given assignments each week, controlling for life circumstances is challenging in applied research. Additional confounders might include whether the participants had access to exercise equipment outside of the Wellness Center and personality traits that might influence their motivation for exercise. Even though we investigated SCT constructs demonstrated in the literature to be associated with physical activity in this type of population it is possible that other mediators exist that we did not test for. A final limitation may be that although the sample size in this study was considered appropriate based on *a priori* analysis it may not have been large enough to detect the significant

relationships between the SCT constructs and physical activity behavior we hypothesized. Generalizing the results from this study is limited to young adult volunteers aged 18-30 (M=22) who were mostly Caucasian (85%) and full-time university students (65%).

Conclusions and Future Directions

This intervention sought to promote regular exercise behavior among sedentary emerging adults based on Social Cognitive Theory. Results for moderate physical activity are encouraging as participants in the treatment group increased their levels of physical activity from baseline at approximately 25 min/wk to meeting ACSM guidelines of accumulating at least 150 minutes per week by the 16th week. Treatment group participants also demonstrated increases in friend social support and self-regulation suggesting the important influence of peers on physical activity behavior and enhanced skills to regulate behavior. Treatment group participants were also able to improve on multiple fitness measures suggesting a positive impact on health outcomes. Body weight was reduced; cardiovascular health was improved through a reduction in Rockport walk time and an increase in predicted VO₂max, and upper body muscular endurance was improved. No significant results were reported for the comparison group. This suggests that participants who have had an orientation to a fitness facility; provided feedback from a fitness assessment; given a sample exercise routine to follow; and given free access to the facility is not enough to keep them motivated to begin exercising regularly. Perhaps it is the developing of mastery experience under the direction of an exercise specialist combined with behavioral strategy acquisition that keeps people exercising. While we

were unable to detect a statistically significant result for the SCT variables predicting physical activity behavior due to a lack of statistical power we feel that the self-regulation construct offers an opportunity for future investigation as it was impacted by this behavioral intervention. Future studies should build upon these results by conducting larger scale studies with an increased sample size and possibly randomizing participants into three groups: one group receiving no treatment as the control; another receiving only the weekly behavioral strategy sessions; and the third group following a prescribed exercise regimen only. This approach may help determine if behavioral strategy sessions alone can predict physical activity behavior rate versus exercise prescription; or if a combination of the two is warranted.

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<http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2009155>

<http://nces.ed.gov/pubs2011/2011033.pdf>

APPENDIX A
Participant Forms

Want to start exercising? Need a place to work out?

Sign up for this FREE 8-week exercise study.

Program begins early January, 2014! Space is limited.

To find out more about this opportunity contact:

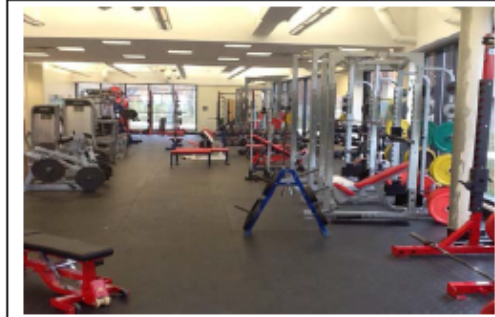
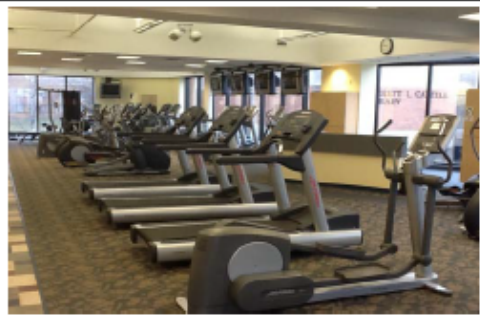
Steve Wirick

Office: 330-471-8295

Cell: 330-806-2465

Email: swirick@malone.edu

Assistant Professor of Exercise Science, Malone University
Doctoral Candidate of the Ohio State University



Eligibility Information:

- **Must** be 18-30 years of age
- **Not** currently exercising regularly
- **Not** pregnant or planning on becoming pregnant in the next 4 months
- **Free** of any medical condition prohibiting you from exercising safely

**The program will take place on the
Campus of Malone University**

2600 Cleveland Ave. NW, Canton, OH 44709

Script Describing the Study

This script will be used during the screening process and can be sent via email or read over the phone by the Co-Investigator.

Hello and thank you for contacting me about this research study. My name is Steve Wirick and I am a PhD student at The Ohio State University in the program of Health and Exercise Science studying Physical Activity Behavior and Health Promotion. I am also an Assistant Professor of Exercise Science at Malone University in Canton, OH.

This exercise program that you are inquiring about is completely voluntary and is designed to provide participants with the necessary skills to become regular exercisers. If you meet the eligibility qualifications for the study, you will be randomly placed into one of two groups. The standard group will receive a fitness assessment, body composition analysis, orientation to the Malone University Wellness Center, an exercise prescription, and unlimited access to the Wellness Center (normal operating hours) during the 8 week study. The other group receives what the standard group receives plus supervised exercise training sessions and every Sunday for 8 consecutive weeks will participate in a 1-hour group exercise behavioral strategy session.

There is no cost to enroll in this study.

It is anticipated that there will be approximately 80 participants in this research study.

Please let me know if you have any questions.

If this sounds like the program for you, then please allow me to gather some information to determine your eligibility.

1. What is your full legal name?

First

Middle

Last

2. Is there another name you prefer to go by? _____

3. Would you prefer to be contacted by phone or email to let you know of your eligibility status for this study?

- If by phone please list phone number and best time to reach you:

○ _____
Phone # Best time of day

- If by email, please print email address on line: _____
Email address

PLEASE SEE the NEXT PAGE for MORE PARTICIPANT ELIGIBILITY QUESTIONS.

Participant Eligibility Screening Form

To be completed in person by the participant, or via email, or information may be recorded over the phone by the Co-Investigator.

The questions below will ask personal information regarding your current health status and determine if you are eligible for this research study.

What is your age in years? _____

Please place an "X" in the box as your answer to each question.	YES	NO
1. Have you participated in a regular planned exercise routine during the past 30 days?		
2. Are you currently enrolled full-time in a 4-year university/college, or 2-year community college?		
3. Do you currently live on a university/college campus in a residence hall?		
4. Are you a member of an athletic team or athletic club?		
5. Are you pregnant?		
6. Do you plan to become pregnant in the next 4 months?		
7. Do you have any known medical conditions that would inhibit your ability to exercise regularly?		
8. Are you available and willing to meet on 8 consecutive Sundays for 1-2 hours in the evening?		
9. Are you available and willing to come back 4 weeks and 8 weeks after the study is over to complete the follow-up assessments?		

**The Promotion of Regular Exercise Behavior among Sedentary Emerging Adults
Based on Social Cognitive Theory**

Demographic data:

Participant name (please print): _____

Assigned ID number: _____

Age in years: _____

Gender (please circle one): Female Male Transgender

Ethnicity (please place a check mark next to the category that best represents you):

- African American
- Asian American
- Caucasian
- Hispanic
- Native American
- Other (please specify): _____

Employment Status (please place a check mark next to the category that best represents you):

- Work full-time (greater than or equal to 32 hours per week)
- Work part-time (less than 32 hours per week)
- Not currently working

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of any other reason why you should not do physical activity?

If
you
answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to **all** PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____

DATE _____

SIGNATURE OF PARENT
or GUARDIAN (for participants under the age of majority) _____

WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

APPENDIX B

Behavioral Strategy Curriculum

“Eating alone will not keep a man well; he must also take to exercise... exercise should be many and of all kinds.” ~Hippocrates

Introduction: What is this program all about?

- **You** becoming a consistent life-long exerciser
- **You** developing an exercise routine that works for you and your busy lifestyle
- **You** achieving your exercise goals
- **You** practicing the necessary skills to maintain adherence to life-long exercise
- **You** finding out what types of exercise you enjoy and can stick with
- **You** overcoming obstacles that get in the way of exercising regularly
- **You** understanding the physiology of exercise in order to achieve health benefits
- **You** developing a positive social support network to maintain an active lifestyle
- **You** identifying fun ways to keep exercising

Let's get started!

“If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health” – Hippocrates

Your path to becoming a regular exerciser begins now!

Introduction: What is this program all about?

- Our main objective with this program is to provide you with the necessary skills to become a lifelong regular exerciser
- Over the next eight weeks you will learn, discuss, develop, practice, and master strategies to maintain a regular personal exercise program tailored to your specific goals
- In addition, you will experience the Wellness Center atmosphere and gain confidence in resistance training and cardiovascular training by participating in

supervised workouts and your own workouts; thus recognizing the physiological changes that occur in the body from short-term and long-term exercise

So...let's get started!



Session 1: Why Being Well Matters

In this session we will:

- Discuss the benefits of regular exercise
- Talk about why regular exercise might be personally important
- Discuss the results from our fitness assessments
- Discuss the SMART system for long-term goal setting
- Write our weekly exercise goals using the SMART system
- Determining our target heart rate range for exercise

So what about those benefits...?

The Researched and Medically Accepted Benefits of Regular Exercise:

- Helps to control weight
- Reduces your risk of cardiovascular disease
- Reduces your risk of Type 2 diabetes and metabolic syndrome
- Reduces your risk of some cancers
- Strengthens your bones and muscles
- Improves your mental health and mood

- Improves your ability to do daily activities
- Increases your chances of living longer
- Improves sleep

What are some other benefits to exercising regularly that you can think of? Write some down and then let's discuss...

Based on all the benefits we've listed and discussed which **3** are **MOST** important to you and why?

1.

2.

3.

Using the SMART System for Long-Term Goal Setting:

Specific: Your goals need to be precise and specifically state what is to be accomplished.

- Does your goal clearly state what you are trying to achieve?
- Example: a general goal would be to improve fitness; a specific goal would be to run a mile in 10 minutes.

Measurable: Your goals must be measurable so there is no doubt if you achieved them or not; this allows you to evaluate your progress.

- Can you put numbers to your outcome?
- Examples: measure time to complete the mile, resting heart rate, amount of weight lifted, days or minutes per week of exercise, percentage of body fat

Attainable: Your goals must be challenging enough but not unrealistic. A delicate balance is necessary here. An easy goal does not motivate but too difficult a goal can bring about failure and frustration.

- What factors might prevent you from accomplishing your goal?

Relevant: Your goals should target your interests, needs, and abilities.

- Why is achieving this goal important to you?

Time-bound: You need to set specific deadlines for completing your goals. Both short-term and long-term timelines can keep you on track.

- When will you reach your goal?

Looking back now on your 3 most important benefits of exercise and considering your fitness assessment results, let's develop an overarching fitness goal that you will achieve in 8 weeks.

What is your personal fitness goal?

Setting Weekly Exercise Goals:

- Will help you attain your personal fitness goal
- Allow you to plan when, where, and how you will exercise each week

Components of weekly exercise goals include:

- What days of the week will you exercise
- What level of intensity will you exercise at: light, moderate, vigorous
- How many minutes will you exercise
- What type of exercise(s) will you perform
- What time of day will you exercise
- Where will you exercise

Write down your exercise goal for the week:

“Of course it’s hard. It’s supposed to be hard. If it was easy everyone would do it. The hard is what makes it great.” – Tom Hanks from the movie *League of Their Own*

Determining your target heart rate range (THRR) for exercise:
Karvonen Heart Rate Calculator

The Karvonen method of calculating your exercise heart rate is considered the gold standard, benefiting athletes, or people who are looking for weight loss and fitness improvement.

As a person becomes more fit, their heart becomes more efficient at pumping blood to the rest of the body. When resting, the number of beats per minute slows down. The Karvonen calculation, devised by a Scandinavian physiologist, takes this into consideration by introducing a number called the *heart rate reserve* into the equation — the difference between your maximal heart rate and your resting heart rate.

To find out what your more accurate target heart rate should be while exercising, you will need to determine your resting heart rate. The best time to check your resting rate is just before you get up in the morning after a good night’s sleep. Take the average of two or three mornings’ readings for greater accuracy.

<http://www.briancalkins.com/HeartRate.htm>

Let’s calculate this:

Step 1: $220 - \underline{\hspace{1cm}}$ (age in years) = $\underline{\hspace{1cm}}$ Maximal Heart Rate (MHR)

Step 2: $MHR - RHR$ (resting heart rate) = heart rate reserve (HRR)
 $\underline{\hspace{1cm}} - \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$ HRR

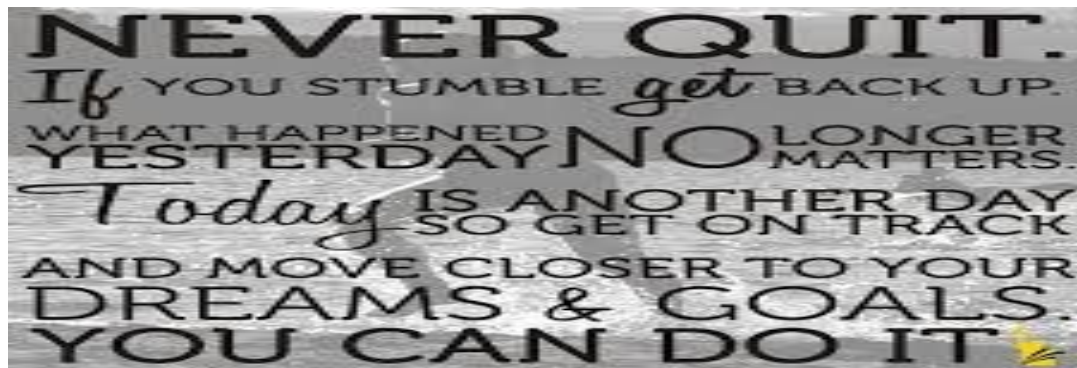
Step 3: $HRR \times .55 + RHR$ = lower end of THHR
 $\underline{\hspace{1cm}}$ (HRR) $\times .55 + \underline{\hspace{1cm}}$ (RHR) = $\underline{\hspace{1cm}}$ bpm (beats per minute)

Step 4: $HRR \times .80 + RHR = \text{upper end of THHR}$
 _____ (HRR) \times .80 + _____ (RHR) = _____ bpm (beats per minute)

Step 5: What is your target heart rate range (THHR)?

_____ - _____

Session 2: Health Related Components of Exercise



Let's review:

- Last week we set a long-term fitness goal and weekly exercise goals. How did we do? Summarize your weekly exercise log below:

<u>Day</u>	<u>Did I exercise?</u>	<u>If no, why not?</u>
Sunday	Yes No	
Monday	Yes No	
Tuesday	Yes No	
Wednesday	Yes No	
Thursday	Yes No	
Friday	Yes No	
Saturday	Yes No	

By logging your exercise, what did you learn?

So there may be some obstacles getting in our way of exercising so next let's see what the most common obstacles are and talk about yours too. Let's complete the worksheet on the next page and find out.

Let's list those barriers from the worksheet and then develop strategies to overcome them:

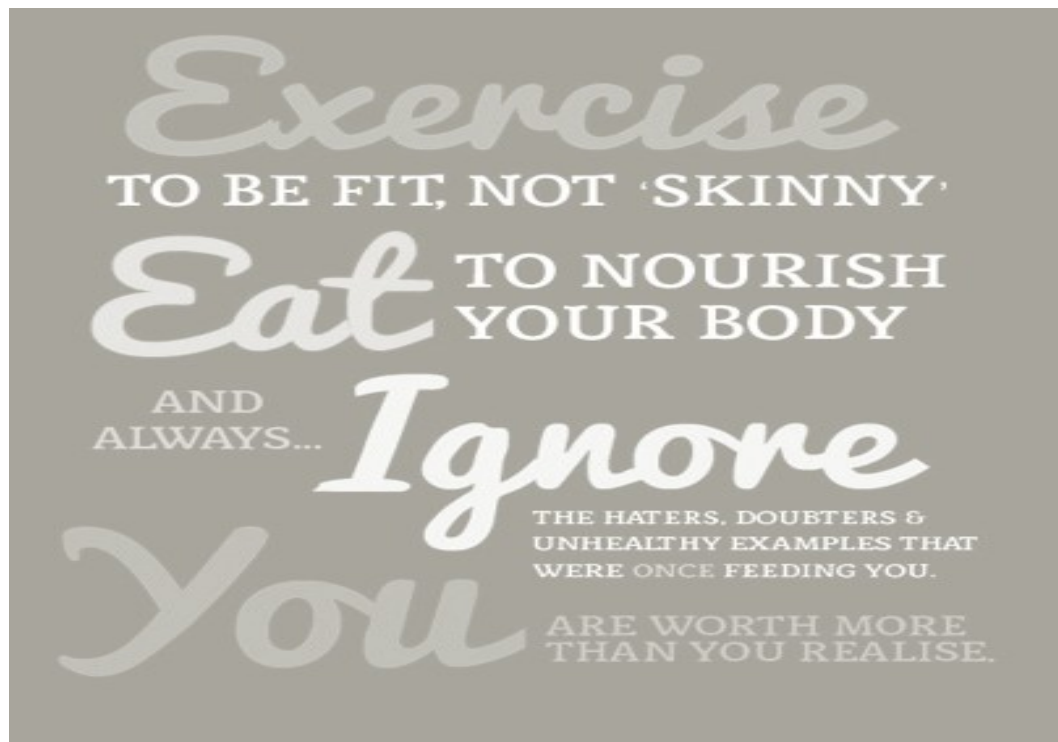
<u>BARRIER</u>	<u>STRATEGY</u>
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The 5 Health Related Components of Exercise

1. Cardiorespiratory Endurance
 - Ability of your cardiovascular and respiratory systems to provide oxygen to working muscles
2. Muscular Strength
 - Ability of your muscles to exert force
3. Muscular Endurance

- Ability of your muscles to contract repeatedly over time
4. Flexibility
- Ability to move your joints in a full range of motion
5. Body Composition
- The relative amounts of fat and lean tissue in your body

Slowing achieving a balance among these health components of exercise over the long-term will have the greatest impact on your health.



Session 3: The FITT Principle and Finding Your Comfort Zone

Let's review last week's exercise log...

- How are we doing with our weekly goals?
- What have been the consistent obstacles these past two weeks?

The FITT Principle:

FITT is an easy way to remember the exercise variables you can manipulate to avoid boredom and to keep your body challenged:

- **Frequency** - how often you exercise
- **Intensity** - how hard you exercise
- **Time** - how long you exercise
- **Type** - the type of exercise you're doing (e.g., running, walking, etc.)

These FITT variables need to be changed every 4-6 weeks to continue to challenge the body and gain the greatest training effects:

- Cardiorespiratory endurance
- Muscular strength
- Muscular endurance
- Flexibility
- Body composition

View CDC video...

So how do we change those variables?

Examples:

- **Frequency** - Add one more day of strength training
- **Intensity** – Increase the level/resistance on the cardio machines
- **Time** - Add 10 minutes to your usual workout time
- **Type** - Do a different activity: cycling, swimming, walk the dog, aerobics, spinning class, P90X, Insanity, yoga, pilates, hiking, rock climbing, anything that you find fun and challenging

Finding Your Comfort Zone

This week we want you to experience three different intensities of cardiovascular exercise, for at least 10 minutes each.

1. Light exercise: raises heart rate a little bit above resting rate;
 - a. 50 – 64% of THRR
2. Moderate exercise: sometimes called the “conversation pace”
 - a. 65 – 79% of THRR

3. Vigorous exercise: rather intense; less talk more action here
 - a. 80% + of THRR

Here's how this works:

- Start out at a slow pace, then medium pace, and finally a fast pace
- Pay close attention to how you feel at these intensity levels
- Complete the chart and answer the questions that follow on the next two pages

Don't fall into the trap of trying to keep up with someone else. This is all about you and finding out what is comfortable and beneficial to YOU!

Intensity #1: Light Exercise

What was your heart rate?	
How did you feel DURING the 10 minutes? Was is easy/hard; did you feel tired/energized, etc...?	
How did you feel IMMEDIATELY after the exercise? Tired/energized, etc...?	
Do you think you could remain at this pace for at least 30 min.?	

Intensity #2: Moderate Exercise

What was your heart rate?	
How did you feel DURING the 10 minutes? Was is easy/hard; did you feel tired/energized, etc...?	
How did you feel IMMEDIATELY after the exercise? Tired/energized, etc...?	
Do you think you could remain at this pace for at least 30 min.?	

Intensity #3: Vigorous Exercise

What was your heart rate?	
How did you feel <u>DURING</u> the 10 minutes? Was it easy/hard; did you feel tired/energized, etc...?	
How did you feel <u>IMMEDIATELY</u> after the exercise? Tired/energized, etc...?	
Do you think you could remain at this pace for at least 30 min.?	

Follow-up questions:

1. During which intensities were you in your target heart rate zone?

2. In which intensity did you feel the most comfortable?

3. Which intensity do you think you could continue at for at least 30 minutes?

Your preferred intensity is: _____

You have now just established your COMFORT ZONE!

Try exercising this week in your COMFORT ZONE.

“Wow, I really regret that workout.” -No one ever

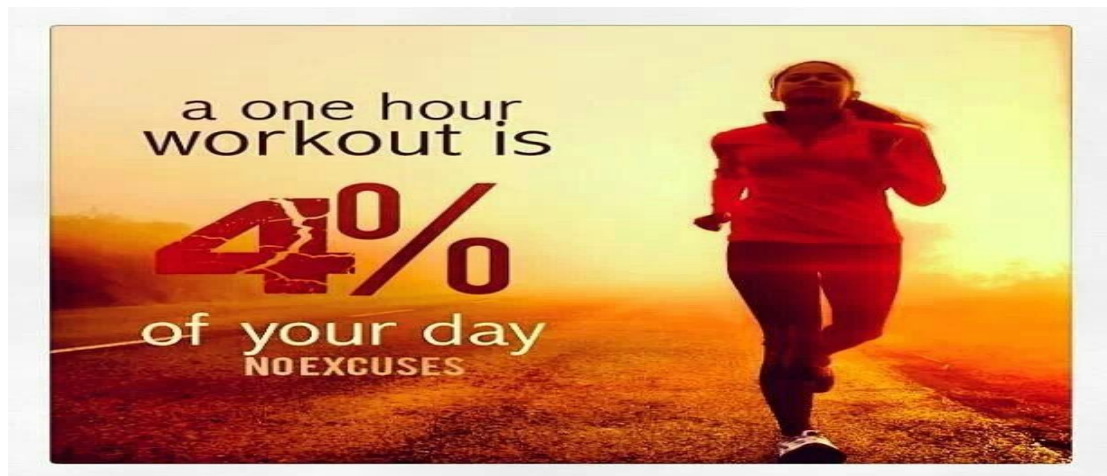
Session 4: Making Time for Exercise

It's trite but true that we all have twenty-four hours in every day. If your excuse for not exercising is "I don't have time", perhaps some of these quotes will push you to rethink...

You will never find time for anything. If you want time, **you must make it.**
– *Charles Buxton*

Those who think they have not time for bodily exercise **will sooner or later have to find time for illness.**
– *Edward Stanley*

Much may be done in those little shreds and patches of time which every day produces, and **which most men throw away.**
– *Charles Caleb Colton*



Let's review your comfort zone...

- Take a look at your answers from the different intensities.
- What did you find out?
- What is your comfort zone?

We now have 3 week's worth of exercise logs. Let's take a look and see what they reveal.

- Are you noticing any patterns / trends?
- What days are you exercising?

- What days are you not exercising?
 - Are there obstacles in the way on those days and if so what are they?
-

Let's now take a look at what you might consider as 2 typical days of your life. On the next 2 pages I want you to complete the time management schedule.

Complete it for this past **WEDNESDAY** and **SATURDAY**.

Why Drinking Water Is Important for Weight Loss

Diet and Weight Loss Tutorial

There are many reasons why it is important to drink water, especially if you are dieting:

- Initial weight loss is largely due to loss of water, and you need to drink an adequate amount of water in order to avoid dehydration.
- The process of burning calories requires an adequate supply of water in order to function efficiently; dehydration slows down the fat-burning process.
- Burning calories creates toxins (think of the exhaust coming out of your car), and water plays a vital role in flushing them out of your body.
- Dehydration causes a reduction in blood volume; a reduction in blood volume causes a reduction in the supply of oxygen to your muscles; and a reduction in the supply of oxygen to your muscles can make you feel tired.
- Water helps maintain muscle tone by assisting muscles in their ability to contract, and it lubricates your joints. Proper hydration can help reduce muscle and joint soreness when exercising.
- A healthy (weight loss) diet includes a good amount of fiber. But while fiber is normally helpful to your [digestive system](#), without adequate fluids it can cause constipation instead of helping to eliminate it.
- Drinking water with a meal may make you feel full sooner and therefore satisfied eating less. Note, however, that drinking water alone may not have this effect. In order to feel satiated (not hungry), our bodies need bulk, calories and nutrients.

How Much Water Should I Drink?

You have probably heard that you should drink eight 8-ounce glasses of water a day. How much water you actually need depends on your weight, level of activity, the temperature and humidity of your environment, and your diet. Your diet makes a

difference because if you eat plenty of water-dense foods like fruits and vegetables your need to drink water will be diminished.

You can do some research and use a calculator and measuring cup if you like, but nature's pretty good at letting you know the right amount to drink. When you drink enough water, your urine will usually be pale yellow, though vitamin supplements and antibiotics can discolor it. On the other hand, you shouldn't need to run to the bathroom too frequently. When in doubt, drink a little more.

Tips on Drinking Water

- Drinking other liquids also provides your body with a source of water, but note that diuretics cause your body to expel water. Diuretics include caffeinated drinks (coffee, tea and soda) and alcohol. When drinking diuretics, drink more water to compensate.
- When you feel thirsty, you are already dehydrated. Try to avoid this situation by drinking in advance. Be especially careful when participating in activities where you won't be able to stop to get caught up.
- You've heard countless advertisements telling you what product to start your day with. We recommend a couple of glasses of water to rehydrate your body. No charge.

Source: http://www.caloriesperhour.com/tutorial_water.php

Session 5: My Social Support Network



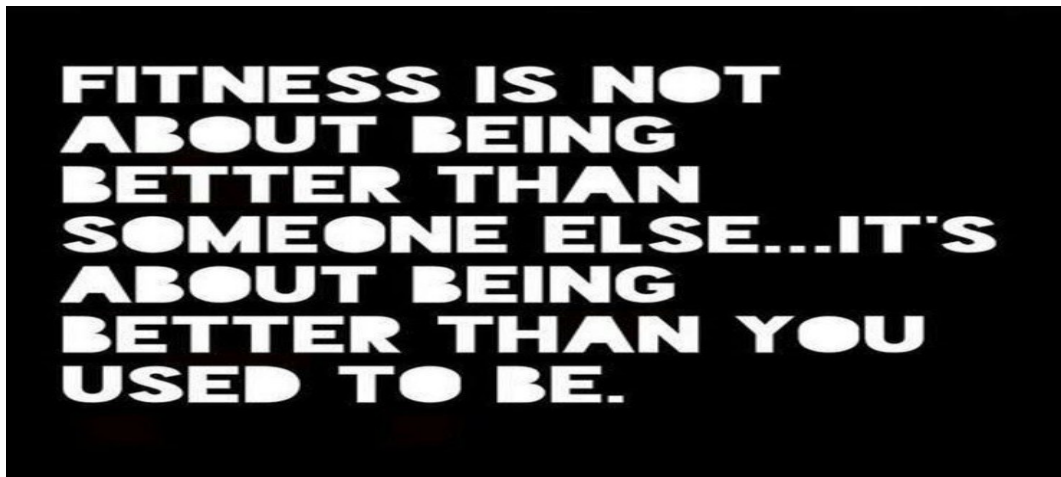
Let's review what we've learned so far these first 4 weeks:

- The many physical and psychological benefits of regular exercise
- Utilizing the SMART system for long-term and short-term goal setting
- Calculation of our target heart rate range using the Karvonen system
- A little bit about our sugar consumption
- Balancing the health related components of exercise
 - Cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition
- The FITT principle and the importance of manipulating the principle for better health gains i.e. changing the frequency, intensity, time, or type of exercise we engage in
- Finding our exercise comfort zone
- How to make time for exercise – we need to schedule it and make it a priority
- The importance of drinking our water

Your Assignments This Week:

1. **Find alternative ways to exercise independent of Malone's Wellness Center**
 - Examples might include: home workout/video/online workout; local community center; stairwell walking at your office (if safe enough to do so); mall walking; attend a group class at your local fitness club, YMCA, gym; an outdoor activity weather permitting, etc...

- Create a list below of what you did and be prepared to celebrate your activities with the group next session



2. Be sure you are reviewing your exercise log and continue making weekly exercise goals.

- What is your exercise goal this upcoming week?

3. Evaluate your social support network.

When trying to adopt a lifestyle that involves regular consistent exercise it is important to have a supportive social environment. Family and friends play a significant role in our lives and can be supporters or detractors of our newly adopted active lifestyle.

In this assignment we want you to seek out family and friends who will **SUPPORT** your weekly exercise goals through tangible ways. Here are some examples in how they can do this:

- **Opportunities/time to be active**
 - Watch the kids so you can go exercise
 - Help with household duties
 - Volunteer to go with you to the gym
 - Research for you other places to exercise

- **Emotional support**
 - Verbal praise

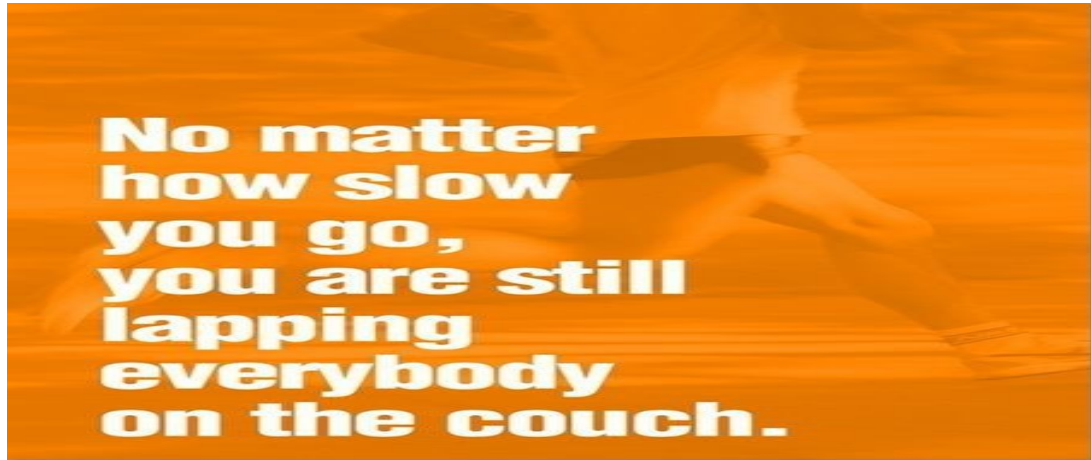
- **Rewards**
 - Prepare for you a healthy meal
 - Go out to dinner together but agree to choose healthy options; maybe limit to a pre-determined calorie intake
 - Purchase new workout gear for you

Now try to identify 3 family/friends you think would be good supporters of your exercise goals and talk to them. Ask them if they would be willing to help you achieve your exercise goals this week.

Complete the following table:

Person giving support	Type of support given	How they agreed to help	Did their support help you reach your goals
Example: -spouse	Opportunities	Put kids to bed so I could workout in the late evening	Yes, was able to get one extra day of exercise in

Session 6: Making Exercise Fun



Our Objectives in this Session:

- Review the past weeks exercise logs
 - How did we do finding new ways/places to exercise?
- Review the social support worksheet
 - Who is part of your positive social support network?
- Review the home workout
 - Did anyone use it?
- Making exercise fun
 - Tracking steps
- New workout sheet

10 Easy Ways to Make Exercise a Habit

Try these tricks to become one of the fitness faithful.

By [Leanna Skarnulis](#)

WebMD Feature

Reviewed by [Louise Chang, MD](#)

Let's face it: it's not all that difficult to start a fitness routine. After all, most of us have done it more than once. The trouble, of course, comes with sticking with it. All too often, our initial enthusiasm and energy wanes, we get distracted by other things going on in our lives, or we don't think we're seeing results quickly enough -- and we throw in the towel.

Yet many people do manage to hang in there, and would no sooner skip their regular workout than their morning shower. What's their secret? A recent study by researcher Diane Klein, PhD, shed some light on the subject. Long-term exercisers (who had been working out for an average of 13 years) were asked to rank what motivated them to keep up with their regimes. Their answers might surprise you. The exercisers were not as concerned with powerful pecs and awesome abs as they were with feeling good and being healthy.

Here's how the study participants ranked their motivators:

- Fitness
- Feelings of well-being
- Pep and energy
- Enjoyment of the exercise
- Making exercise a priority
- Sleeping better
- Feeling alert
- Being relaxed
- Weight management
- Appearance

So, once you have your priorities in the right place, how can you become one of the fitness faithful? WebMD has compiled 10 tips for making fitness a habit in your life. To create the list, we sought the help of Klein, along with long-term fitness buff Roy Stevens and his wife, Wanda, who is transforming her hit-and-miss exercise schedule into an almost-daily habit.

1. Do a variety of activities you enjoy. And remember, there's no rule that says you have to go to a gym or buy equipment. "We've shifted our perceptions from regimented exercise to physical activity," says Klein, assistant professor of exercise, sports and leisure studies, and director of gerontology at the University of Tennessee, Knoxville. Having a variety of activities -- weight lifting, walking, running, tennis, cycling, aerobics classes -- will ensure that you can do *something* regardless of the weather or time of day.

2. Commit to another person. "The social aspect of exercise is important for me," says Wanda Stevens, a stay-at-home mom in Austin, Texas. "I'll let myself off, but if I've agreed to walk with a friend after dinner, I won't let them down." She is six weeks into an exercise program, thanks in part to her husband's support. Roy Stevens, who works as a management consultant, has become her "in-house personal trainer." They work out together every morning, doing a combination of aerobics, strength training, Tae Bo, and stretching. If he's out of town, he gives her a wake-up call, and she takes the dog for a walk.

3. Make exercise a priority. "It has to be a non-negotiable," says Roy Stevens. He began exercising to manage his weight when he was in the Air Force band some 20 years ago. "We'd travel, and other guys would get off the bus and go eat wings and drink beer. I'd go running." He's maintained the exercise habit even during his years working 70 hours a week as a restaurant owner. There's another advantage to making exercise non-negotiable. Friends and family members learn that it's part of your identity, and give up saying things like, "Why don't you take it easy today?"

4. Exercise first thing in the morning. With two preschool children, Wanda Stevens couldn't find time to work out except on a hit-and-miss basis. Any number of things could sabotage her good intentions to walk or go to Pilates class after dinner. But all her excuses vanished once she started getting up before the kids so she could work out. "I didn't think I was a morning person," she tells WebMD. "But it's working for me." Experts agree that a morning schedule is best. "If you go to a gym, it should be located between your home and work," says Klein. "Exercise, take a shower, and you're energized for the day."

5. Or, exercise on your way home from work. The next best thing to exercising first thing in the morning is to do it on your way home from work, Klein says. "Don't go home first," she says. "I learned that the hard way. There aren't a lot of people who are so motivated that after they go home and change clothes will go back out again and exercise."

6. Exercise even when you're "too tired." Chances are, you'll feel better after exercising. "It energizes us," says Klein. "You breathe deeply, and your body makes better use of the oxygen exchange. You'll get an exercise-induced euphoria during the activity and for some time after. "If Wanda Stevens thinks she is too tired to get up and exercise, Roy shows her no sympathy."She gets mad, but then she feels better afterwards," he says.

7. Log your activity. Write down the things that are important to you. It could be how much time you exercise each day, how many steps you walked, how far you ran or cycled, what you weighed, etc. Some people make a game of it. You may have heard of runners calculating the miles it would take to run from their homes to Boston (home of the famous marathon), figuring how far they run in an average week and setting a target date for "arriving" in Boston.

8. Be aware of all the indicators of progress. It's great when your clothes fit better and you can lift heavier weights or work out longer without getting exhausted. But there are a slew of other progress indicators, such as:

- Getting a good night's sleep.
- Thinking more clearly.
- Having more energy.

- Realizing your muscles aren't screaming after you've helped a friend move furniture.
- Seeing your resting heart rate drop over time.
- Hearing your doctor congratulate you on improved cholesterol, blood pressure, bone density, triglycerides, and blood sugars.

9. Walk -- with a pedometer (or a dog). "If you enjoy walking and haven't exercised for awhile, 10 minutes three times a day will give you 30 minutes," says Klein. Use a pedometer, and work up to at least 10,000 steps a day. "Nobody starts out with 10,000 steps," Klein says. Find out what your daily average is, and, the next week, strive to walk 300 extra steps each day. Increase your steps each week. "Better yet, walk the dog," Klein says. That's how she motivated her sister to exercise. "Twice a day she walks her dog, which is good for them both and provides companionship." Wanda Stevens also enjoys walking her border collie and finds there's another benefit: "It relieves the guilt I felt over not giving her enough attention now that we have kids."

10. Reward yourself. Are you telling yourself that you don't deserve a reward for something you should be doing anyway -- or that once you can zip your jeans without lying on the bed, that will be reward enough? Well, honestly, how inspiring is *that*? Experts say that making behavior changes is hard, and rewards motivate. So decide on a goal and a reward, and work toward it. You might buy yourself a video you've wanted after you stick to your fitness plan for one month, or buy new walking shoes when you achieve 5,000 steps a day. Do whatever works for you.

By incorporating some of the strategies above, we want you to work on increasing your activity levels.

We've assigned you an exercise goal for this week:

- Using the pedometer provided to you keep track of how many steps you take every day.
- **Your goal is to achieve an average of 10,000 steps per day for the week.**
- Using the chart on the next page, track your steps for the week.

IM NOT TRAINING FOR A 5K. IM NOT PREPARING FOR A COMPETITION. IM NOT TRYING TO SET A NEW RECORD. IM NOT TRYING TO IMPRESS YOU. IM SAVING MY LIFE.

Step Record Sheet

Name: _____

Date/Day of Week Begin End Time Worn # Steps

Total Time Worn:			Total Steps:	
Average Time Per Day:			Average Steps Per Day:	

What was unique about the days you stepped the **MOST**?

What was unique about the days you stepped the **LEAST**?

Session 7: Why is Exercise Important Again?

First let's review our step sheet from this past week. How did we do?

“For both excessive and insufficient exercise destroy one's strength, and both eating and drinking too much or too little destroy health, whereas the right quantity produces, increases and preserves it. So it is the same with temperance, courage and the other virtues. This much then, is clear: in all our conduct it is the mean that is to be commended.” ~Aristotle (384 - 322 BC)

Remember week 1 when we talked about the benefits of exercise? Go back and look at that first assignment where you listed the 3 most important benefits of exercise. Are they different? Has your perception of the benefits of exercise changed?

Based on all the benefits of exercise you've experienced these past 7 weeks, which **3** are now **MOST** important to you and why?

1.

2.

3.

Basic Nutrition

Assignment this week:

- Log on to www.choosemyplate.gov
 - Click on ‘daily food plans’
 - Click on ‘daily food plan’ again under main body of text
 - Enter your information to estimate how many calories you need daily
- What are you total daily caloric needs? _____ calories

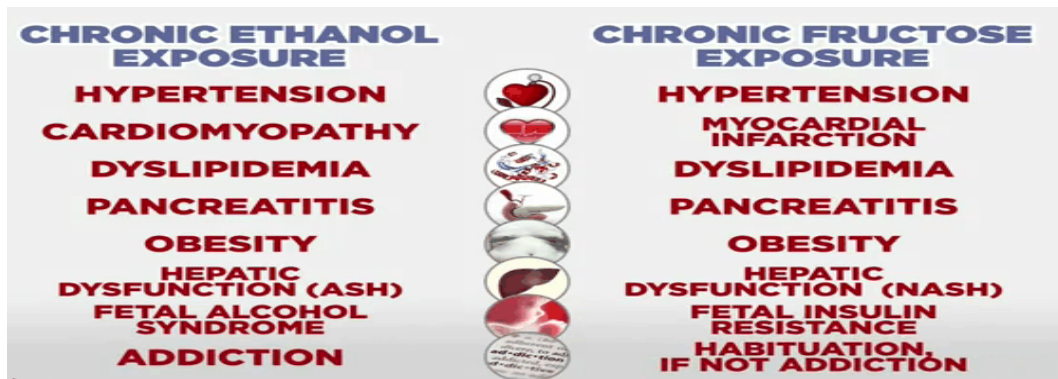
Now keep track of your total caloric intake and grams of sugar consumed for the next 7 days:

- Monday: _____ calories Sugar: _____ grams
- Tuesday: _____ calories Sugar: _____ grams
- Wednesday: _____ calories Sugar: _____ grams
- Thursday: _____ calories Sugar: _____ grams
- Friday: _____ calories Sugar: _____ grams
- Saturday: _____ calories Sugar: _____ grams
- Sunday: _____ calories Sugar: _____ grams

This should be fun! Remember we should only be consuming between **26 and 37** grams of sugar per day. I love a glass of orange juice every morning but:

- **8 ounces of OJ = 22g of sugar**

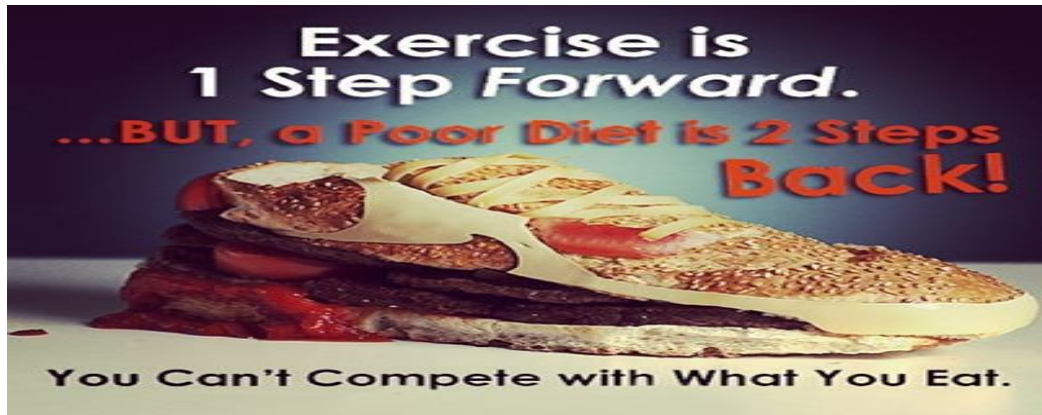
Check out www.calorieking.com for great information on your favorite restaurant!



Listed below are some documentaries on nutrition you might find interesting:

- Weight of the Nation – 4 part series
- Globesity
- Genetic Roulette
- Sugar: The Bitter Truth
- Food, Inc.
- Seeds of Freedom
- Seeds of Death
- Way Beyond Weight
- Fast Food, Fat Profits: Obesity in America
- Fast Food Baby
- Food Matters
- Super Size Me

If you have an I-pad or similar device and internet access you could watch most of these from the website www.topdocumentaries.com while you cardio!



Session 8: Adhering to My New Lifestyle

Stop beating yourself up! You are a work in progress, which means you get there a little at a time, not all at once.

Let's take a look at our dietary habits from last week.

- How did we do?
- How was our balance of calories?
- How much sugar did we consume?
- Anyone watch any of the documentaries? What did you think?

How are we doing on our weekly exercise goals?

- Let's reflect back over the past 7 weeks and see how we've done

Write down some patterns you've noticed, obstacles you had to overcome, how your goals changed during the past 7 weeks...

This week we want to focus on setting long-term goals using the SMART system:

Using the SMART System for Long-Term Goal Setting:

Specific: Your goals need to be precise and specifically state what is to be accomplished.

- Does your goal clearly state what you are trying to achieve?
- Example: a general goal would be to improve fitness; a specific goal would be to run a mile in 10 minutes.

Measurable: Your goals must be measurable so there is no doubt if you achieved them or not; this allows you to evaluate your progress.

- Can you put numbers to your outcome?
- Examples: measure time to complete the mile, resting heart rate, amount of weight lifted, days or minutes per week of exercise, percentage of body fat

Attainable: Your goals must be challenging enough but not unrealistic. A delicate balance is necessary here. An easy goal does not motivate but too difficult a goal can bring about failure and frustration.

- What factors might prevent you from accomplishing your goal?

Relevant: Your goals should target your interests, needs, and abilities.

- Why is achieving this goal important to you?

Time-bound: You need to set specific deadlines for completing your goals. Both short-term and long-term timelines can keep you on track.

- When will you reach your goal?

On the next page we want you to develop some long-term exercise goals...

One month exercise goal:

Three month exercise goal:

Six month exercise goal:

One year exercise goal:

On **Sunday, April 13** we would like to meet again from **6-8 PM** to complete the questionnaires and fitness assessments.

We will do this one more time on **Sunday, May 11** from **6-8 PM**. On this date we will award those who have won the heart rate monitors and conduct the BODPOD body composition test **ONLY** for those who would like to have it done; this is not required.

Be on the lookout for email reminders from me!

“Exercise like your life depends on. Oh that’s right, it does!”

• CHANGING YOUR SEDENTARY TIME INTO ACTIVE TIME

Name: _____ Date: _____

Instructor: _____ Section: _____

Purpose: To create a plan for reducing your sedentary time and replacing it with active time.

Directions:

1. On Worksheet A, list your typical activity for each hour of your day in the column labeled "Activity."

Worksheet A

Time of Day	Activity	Revised Activity
6:00 AM		
7:00 AM		
8:00 AM		
9:00 AM		
10:00 AM		
11:00 AM		
12:00 PM		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
5:00 PM		
6:00 PM		
7:00 PM		
8:00 PM		
9:00 PM		
10:00 PM		
11:00 PM		

EXERCISE LOG

Weekly Exercise Goal: _____

Track your cardio and strength training progress

DATE: _____

<u>STRENGTH EXERCISES</u>	<u>SETS</u>	<u>REPS</u>	<u>WT</u>	<u>CARDIO EXERCISES</u>	<u>TIME</u>	<u>DIST</u>	<u>INT*</u>

*INT: Intensity; light (L), moderate (M), or vigorous (V)

DATE: _____

<u>STRENGTH EXERCISES</u>	<u>SETS</u>	<u>REPS</u>	<u>WT</u>	<u>CARDIO EXERCISES</u>	<u>TIME</u>	<u>DIST</u>	<u>INT*</u>

*INT: Intensity; light (L), moderate (M), or vigorous (V)

DATE: _____

<u>STRENGTH EXERCISES</u>	<u>SETS</u>	<u>REPS</u>	<u>WT</u>	<u>CARDIO EXERCISES</u>	<u>TIME</u>	<u>DIST</u>	<u>INT*</u>

*INT: Intensity; light (L), moderate (M), or vigorous (V)

DATE: _____

STRENGTH EXERCISES	SETS	REPS	WT	CARDIO EXERCISES	TIME	DIST	INT*

*INT: Intensity; light (L), moderate (M), or vigorous (V)

DATE: _____

STRENGTH EXERCISES	SETS	REPS	WT	CARDIO EXERCISES	TIME	DIST	INT*

*INT: Intensity; light (L), moderate (M), or vigorous (V)

After you exercised, how did you feel?

Which exercises or activities did you like?

Which exercises or activities did you find hard?

APPENDIX C

Supervised Exercise Sessions

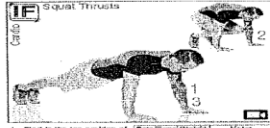


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Circuit

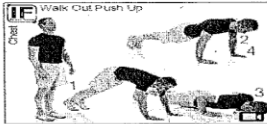
Perform each exercise in the workout one after another, and repeat. This is one circuit.



- Squat Thrusts**
1. Start in the top position of a push up with your legs and arms straight and your hands on the floor.
 2. Jump your feet in, bringing your knees to your chest while keeping your hands on the floor.
 3. Jump your feet back out to a straight position.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Step Up Balance**
1. Stand upright with one foot on a step or bench with your arms at your sides.
 2. Step up onto the bench by pushing down on your front foot and raise your other leg up with a 90 degree angle at the knee.
 3. Step down off the bench onto the back foot and repeat.
 4. Complete all reps on one side before switching to the other.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Walk Out Push Up**
1. Stand upright with your arms by your sides.
 2. Bend forward at the waist and place your hands on the floor in front.
 3. Walk your hands out until your body is straight in the top position of a push up.
 4. Perform a push up then walk your hands back in and return to the upright position.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Mountain Climber**
1. Support your body on your arms and hands with your arms straight.
 2. Bring your knees in toward your chest, keeping the feet of your body in the air in our position.
 3. Straighten the leg and repeat on the other side.
 4. Keep your back flat and your hips in line with your shoulders throughout.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Lower Body Twist**
1. Lie on your back with your knees bent and feet raised, with your hands at your sides.
 2. Lift your legs to one side, turning your knees to the floor.
 3. Pull your legs to the opposite side to touch, keeping your knees bent and your upper body straight through out.
 4. Alternate sides with each rep.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Foot Up Split Squat**
1. Stand upright with one foot on a bench behind with your arms by your sides.
 2. Drop your body down over the low foot, landing at your hips and knees and keeping your torso slightly forward.
 3. Push off your front foot to return to the upright position.
 4. Complete all reps on one side before switching to the other.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Vertical Jump**
1. Stand upright with your arms by your sides.
 2. Bend at the hip, and knees into a squat position, lowering your torso slightly forward.
 3. Push off your feet, jumping straight up and raising your arms up overhead.
 4. Land in a controlled way with your arms back by your sides and repeat the move.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |



- Alternating V-Up**
1. Lie on your back with your legs straight and your arms extended out overhead.
 2. Raise one leg straight up while also lifting your upper body off the floor and touch your knee to hand and touch your feet to hand.
 3. Lower both and repeat using the opposite leg and hand.
 4. Alternate sides with each rep.
- | Reps | Time | Weight | Notes |
|------|------|--------|-------|
| 1 | 10 | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |

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Push Up

- Support your body on your hands and feet with your elbows bent and your chest nearly touching the floor.
- Push up to a straight arm position.
- Lower your body back to the start position and repeat.
- Keep your back flat and your hips in line with your shoulders throughout.

Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Bent Over Row

- Bend forward at your waist with your knees slightly bent and your back flat while holding dumbbells with your arms straight and palms facing in.
- Lift the dumbbells up to the sides of your chest.
- Lower the dumbbells back to a straight arm position, keeping your back flat throughout.

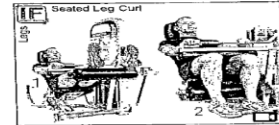
Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Leg Extension

- Sit in the leg extension machine with your knee on the pad and the leg pads on your lower shins just above your ankles.
- Extend your knees fully, raising your legs out and up to where your feet, knees and hip are in line.

Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Seated Leg Curl

- Sit on the leg curl machine with your knee on the pad and your leg straight up in front.
- Push the pad down and back, bending at the knee.

Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Twisting Curl

- Stand upright holding the dumbbells by your sides with your arms straight and your palms facing inward.
- Raise the dumbbells up to your shoulders, turning at the wrists, ending with your palms facing back.
- Keep your elbows close to your sides throughout and do not swing your arms or upper body.

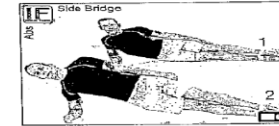
Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Cable Pushdown

- Grip the rope-handle in both hands at chest level with your elbows bent.
- Push the handles down, fully extending your arms and keeping your shoulders steady.
- Your hands should both sit at the top of your thighs in the downward position.

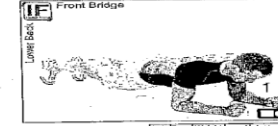
Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



Side Bridge

- Lie on one side propped up on one elbow with your legs straight out on top of one another.
- Raise your body off the floor, resting on your forearm and feet.
- Try to keep your body in a straight line and your elbow directly under your shoulder.
- Hold, then lower yourself back to the floor and repeat.

Set	Reps	Weight	Notes
1	10		Keep one knee up
2	10		
3			
4			
5			
6			



Front Bridge

- Lie face down on the floor with your legs straight and arms tucked in by your sides.
- Raise your body off the floor, resting on your knees and feet.
- Try to maintain your body in a straight line and keep your back neutral.
- Hold briefly, then lower yourself back to the floor and repeat.

Set	Reps	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



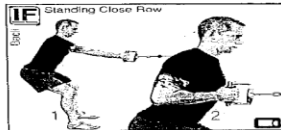
IronFitness: HERE IS YOUR WORKOUT



IF Bench Press

1 - Lie on a bench holding dumbbells at shoulder level with your elbows bent.
 2 - Press the dumbbells up over your chest, straightening your arms.
 - Lower the dumbbells back to shoulder level and repeat.
 Equipment Sub: Barbell

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Standing Close Row

1 - Stand upright holding the handle with your arms straight out in front, your knees slightly bent and your back flat.
 2 - Pull the handle straight in to your chest.
 - Remain upright throughout and do not sway back and forth.
 Equipment Sub: Tying

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Front Squat

1 - Hold dumbbells at your shoulders with your palms in and your feet shoulder-width apart.
 2 - Squat down, sending your hips back, bending your knees and keep the dumbbells at shoulder height.
 3 - Push through your heels to return to the start position, keeping your back flat throughout.

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Hammer Curl

1 - Stand upright holding dumbbells with your arms straight by your sides, palms facing inward.
 2 - Raise the dumbbells up to shoulder height, bending at the elbows.
 - Do not flare at the wrist.
 Equipment Sub: Kettlebells

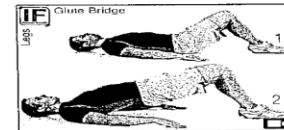
Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Kickback

1 - Bend forward at the waist holding dumbbells with your upper arms by your sides and elbows bent.
 2 - Lift the dumbbells up and back, straightening your arms, keeping your shoulders steady and your back flat throughout.
 - Return to the start position and repeat.

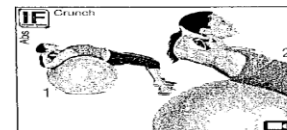
Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Glute Bridge

1 - Lie on your back with your knees bent and feet flat, placing your hands at your sides.
 2 - Raise your hips off the floor, trying to make a straight line from your hips to your shoulders.
 - Lower yourself back to the floor and repeat.

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Crunch

1 - Lie with the center of your back on the ball, hands at the sides of your head and your feet flat, knees bent.
 2 - Lift your head and shoulders off the ball, contracting your abdominal muscles and do not put your head up with your hands.
 - Lower your head and shoulders and repeat.

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			



IF Kneeling Back Extension

1 - Kneel on the floor with your chest on the ball and your hands at the sides of your head.
 2 - Lift your chest up off the ball, coming to an upright position.
 - Slowly lower yourself back to the ball and repeat.
 - Do not lean back and do not sit on the ball as you do each rep.

Reps	Sets	Weight	Notes
1	10		
2	10		
3			
4			
5			
6			

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IF Side Lunge

- Stand upright holding the dumbbells by your sides with your arms straight.
- Step laterally to one side, lowering your body down and leaning your torso slightly forward with your weight on the outside leg.
- Push off your outside foot to return to the start position.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Bent Over Row

- Hold a dumbbell in one hand with your arm straight, place the opposite knee and hand on a bench, keeping your back flat.
- Lift the dumbbell up to the side of your chest, bending at your elbow.
- Lower the dumbbell back to a straight arm position, keeping your back flat throughout.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Flat Fly

- Lie on your back holding dumbbells up over your chest with your arms straight.
- Lower the dumbbells out and away from your body and down to shoulder level.
- Raise the dumbbells back up over your chest, keeping your arms straight throughout.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Reciprocal Bench Press

- Lie on a bench with one dumbbell at shoulder level with your elbow bent and the other up over your chest with your arm straight.
- Press one dumbbell up until your arm is straight while lowering the other to shoulder level.
- Both dumbbells should be moving at the same time, but in opposite directions.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Chair Knee Raise

- Support your body with your forearms on the seats of a power station and your legs straight.
- Raise your knees up and to your chest, allowing your lower back to round slightly.
- Lower your legs down straight and repeat.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Upright Row

- Stand upright holding the dumbbells at your thighs with your arms straight and palms facing back.
- Raise the dumbbells up to just below your chin, keeping your elbows above your hands.
- Keep the dumbbells close to your body.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Seated Arnold Press

- Sit upright holding dumbbells at shoulder height with your elbows bent and your palms facing back.
- Press the dumbbells overhead, extending your arms fully and turning at the wrists to finish with palms facing out.
- Lean your back flat and remain upright throughout the movement.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Walking Lunge

- Stand upright holding dumbbells by your sides with arms straight.
- Take a step forward, dropping your back knee down and leaning your torso slightly forward with your weight on your front leg.
- Push off your front foot and take a step forward, dropping down into a lunge on the other side.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

IF Seated High Row

- Sit holding a rope with a wide grip, your arms straight over shoulder height and your back flat.
- Pull the rope handles straight to the sides of your chest, bending at the elbows.
- Finish upright throughout and do not sway back and forth.

Set	Reps	Weight	Notes
1			
2			
3			
4			
5			
6			

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APPENDIX D

Fitness Measures

Rockport One-Mile Walk Treadmill Test

1. Have the client slowly warm-up while establishing a rate at which they can walk for one mile, preferably with the pulse above 120 (above about 45 % of the VO_2 max). For ease of calculation use a speed to the nearest half mile per hour. Once the pace is established, press "begin" or "reset" (depending upon the treadmill type).
2. Record the pace in miles per hour (3 mph, 3.5 mph, 4 mph, etc.).
3. After finishing one mile exactly, immediately take the pulse for ten seconds. Multiply this by 6 for the one minute pulse. (The ideal is to obtain pulse during the last minute of exercise with a heart rate monitor.)
4. Have the subject cool down with a 5 minute walk.

The following regression equation is recommended by the ACSM. This will allow the calculation of the relative value in $\text{ml} \times \text{kg}^{-1} \times \text{min}^{-1}$:

$$\text{VO}_2 \text{ Max} = 132.853 - (.3877 \times \text{Age}) - (.0769 \times \text{Wt}) - (3.2649 \times \text{T}) - (.1565 \times \text{HR}) + (6.315 \times \text{Gender})$$

Where:

Wt	=	weight in pounds
Age	=	present age
Gender:		male = 1, female = 0
T	=	Time in decimal minutes
Units	=	ml/kg/min

Normative data for VO2max

Female (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<25.0	25.0 - 30.9	31.0 - 34.9	35.0 - 38.9	39.0 - 41.9	>41.9
20-29	<23.6	23.6 - 28.9	29.0 - 32.9	33.0 - 36.9	37.0 - 41.0	>41.0
30-39	<22.8	22.8 - 26.9	27.0 - 31.4	31.5 - 35.6	35.7 - 40.0	>40.0
40-49	<21.0	21.0 - 24.4	24.5 - 28.9	29.0 - 32.8	32.9 - 36.9	>36.9
50-59	<20.2	20.2 - 22.7	22.8 - 26.9	27.0 - 31.4	31.5 - 35.7	>35.7
60+	<17.5	17.5 - 20.1	20.2 - 24.4	24.5 - 30.2	30.3 - 31.4	>31.4

Male (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<35.0	35.0 - 38.3	38.4 - 45.1	45.2 - 50.9	51.0 - 55.9	>55.9
20-29	<33.0	33.0 - 36.4	36.5 - 42.4	42.5 - 46.4	46.5 - 52.4	>52.4
30-39	<31.5	31.5 - 35.4	35.5 - 40.9	41.0 - 44.9	45.0 - 49.4	>49.4
40-49	<30.2	30.2 - 33.5	33.6 - 38.9	39.0 - 43.7	43.8 - 48.0	>48.0
50-59	<26.1	26.1 - 30.9	31.0 - 35.7	35.8 - 40.9	41.0 - 45.3	>45.3
60+	<20.5	20.5 - 26.0	26.1 - 32.2	32.3 - 36.4	36.5 - 44.2	>44.2

Table Reference: The Physical Fitness Specialist Certification Manual, The Cooper Institute for Aerobics Research, Dallas TX, revised 1997 printed in Advance Fitness Assessment & Exercise Prescription, 3rd Edition, Vivian H. Heyward, 1998.p48

Push-up Upper Body Muscular Endurance Test

Equipment

Mat or towel (optional)

Preparation

In this test, you will perform either standard push-ups or modified push-ups, in which you support yourself with your knees. The Cooper Institute developed the ratings for this test with men performing push-ups and women performing modified push-ups. (Biologically, males tend to be stronger than females; the modified technique reduces the need for upper-body strength in a test of muscular endurance.) Therefore, for an accurate assessment of upper-body endurance, men should perform standard push-ups and women should perform modified push-ups. (However, in using push-ups as part of a strength training program, individuals should choose the technique most appropriate for increasing their level of strength and endurance regardless of gender.)



(a) Push-up.



(b) Modified push-up.

Instructions

1. *For push-ups:* Start in the push-up position with your body supported by your hands and feet. *For modified push-ups:* Start in the modified push-up position with your body supported by your hands and knees. *For both positions,* your arms and your back should be straight and your fingers pointed forward.
2. Lower your chest to the floor with your back straight, and then return to the starting position.
3. Perform as many push-ups or modified push-ups as you can without stopping.

Number of push-ups: or number of modified push-ups:

Rating Your Push-Up Test Result

Your score is the number of completed push-ups or modified push-ups. Refer to the appropriate portion of the table below for a rating of your upper-body endurance. Record your rating below and in the chart at the end of this lab.

Rating:

Ratings for the Push-Up and Modified Push-Up Tests

Men		<i>Number of Push-Ups</i>					<i>Superior</i>
		<i>Very Poor</i>	<i>Poor</i>	<i>Fair</i>	<i>Good</i>	<i>Excellent</i>	
Age:	18-29	Below 22	22-28	29-36	37-46	47-61	Above 61
	30-39	Below 17	17-23	24-29	30-38	39-51	Above 51
	40-49	Below 11	11-17	18-23	24-29	30-39	Above 39
	50-59	Below 9	9-12	13-18	19-24	25-38	Above 38
	60 and over	Below 6	6-9	10-17	18-22	23-27	Above 27

Women		<i>Number of Modified Push-Ups</i>					<i>Superior</i>
		<i>Very Poor</i>	<i>Poor</i>	<i>Fair</i>	<i>Good</i>	<i>Excellent</i>	
Age:	18-29	Below 17	17-22	23-29	30-35	36-44	Above 44
	30-39	Below 11	11-18	19-23	24-30	31-38	Above 38
	40-49	Below 6	6-12	13-17	18-23	24-32	Above 32
	50-59	Below 6	6-11	12-16	17-20	21-27	Above 27
	60 and over	Below 2	2-4	5-11	12-14	15-19	Above 19

SOURCE: Based on norms from the Cooper Institute for Aerobics Research, Dallas, Texas; from *The Physical Fitness Specialist Manual*, Revised 2002. Used with permission.

Participant:

Baseline

Gender: _____ Age: _____ Weight: _____ pounds

Heart rate: _____ bpm Time: _____ min; _____ sec

VO₂max: _____ ml/kg/min

Estimated fitness rating: _____

Post-test

Gender: _____ Age: _____ Weight: _____ pounds

Heart rate: _____ bpm Time: _____ min; _____ sec

VO₂max: _____ ml/kg/min

Estimated fitness rating: _____

8-week follow-up

Gender: _____ Age: _____ Weight: _____ pounds

Heart rate: _____ bpm Time: _____ min; _____ sec

VO₂max: _____ ml/kg/min

Estimated fitness rating: _____

Push-up Test

Participant:

Baseline

Gender: _____ Age: _____ Repetitions: _____

Rating: _____

Post-test

Gender: _____ Age: _____ Repetitions: _____

Rating: _____

8-week follow-up

Gender: _____ Age: _____ Repetitions: _____

Rating: _____

APPENDIX E

Social Cognitive Theory Measures

SELF-EFFICACY

Using the scale below as a yardstick, please answer the following:

How confident are you that you could exercise under each of the following conditions over the next 6 months?

0%====10%====20%====30%====40%====50%====60%====70%====80%====90%====100%

**I CANNOT do
it at all**

**MODERATLY certain that
I CAN do it**

**CERTAIN that I
CAN do it**

On the line next to each item, write the percentage of confidence you have in exercising under the following conditions:

Confidence rating: 0-100%

1. I could exercise when I am tired. _____
2. I could exercise during or following a personal crisis. _____
3. I could exercise when feeling depressed. _____
4. I could exercise when feeling anxious. _____
5. I could exercise during bad weather. _____
6. I could exercise when sore from the last work-out. _____
7. I could exercise when on vacation. _____
8. I could exercise when there are competing interests (e.g. watching television). _____
9. I could exercise when I have a lot of work to do. _____
10. I could exercise when I don't receive support from my family/friends. _____
11. I could exercise when I have no one to exercise with. _____
12. I could exercise when my schedule is hectic. _____
13. I could exercise when exercising is not enjoyable. _____
14. I could exercise when I haven't reached my exercise goals. _____

SELF-REGULATION

People use various techniques to help them exercise on a regular basis. Recalling your exercise activities performed in the last four (4) weeks please answer the following questions regarding techniques you may have used to help you exercise.

On the scale provided next to each item, circle the number that best represents how often you used the specified technique in the past four (4) weeks.

If you did not exercise during this time period, circle “1” which corresponds to “Never”.

	<u>Never</u>	<u>Rarely</u>	<u>Sometimes</u>	<u>Often</u>	<u>Very Often</u>
15. I mentally kept track of my exercise activities.	1	2	3	4	5
16. I mentally noted specific things which helped me exercise.	1	2	3	4	5
17. I recorded my exercise activities in a written record.	1	2	3	4	5
18. I recorded my exercise activities in a written record including duration or intensity of exercise performed.	1	2	3	4	5
19. I kept a written record of specific methods used to enhance my ability to perform exercise.	1	2	3	4	5
20. I established short term goals (daily or weekly) related to how often I exercise.	1	2	3	4	5
21. I established long term goals (monthly or longer) related to how often I exercise.	1	2	3	4	5
22. I established goals for exercise time or distance (e.g. swim 20 minutes, run 3 miles).	1	2	3	4	5
23. I established exercise goals that focused on my health (e.g. improved fitness).	1	2	3	4	5
24. I established exercise goals that focused on my appearance (e.g. lose weight, tone body).	1	2	3	4	5
25. I established a written commitment with others to exercise.	1	2	3	4	5
26. I established an oral commitment with others to exercise regularly.	1	2	3	4	5
27. I mentally set exercise goals.	1	2	3	4	5
28. I wrote down my exercise goals.	1	2	3	4	5

	<u>Never</u>	<u>Rarely</u>	<u>Sometimes</u>	<u>Often</u>	<u>Very Often</u>
29. I exercised with someone to help me exercise regularly.	1	2	3	4	5
30. I exercised with a pet to help me exercise regularly.	1	2	3	4	5
31. I talked to someone while I exercised to help me exercise regularly.	1	2	3	4	5
32. I received verbal praise from someone for exercising.	1	2	3	4	5
33. I received a reward from someone for exercising.	1	2	3	4	5
34. I asked someone to remind me to exercise.	1	2	3	4	5
35. I asked someone to assume some of my responsibilities so I could exercise.	1	2	3	4	5
36. I asked someone I know for advice or demonstration of exercise activities.	1	2	3	4	5
37. I asked an exercise expert/health professional for advice or demonstration of exercise activities.	1	2	3	4	5
38. I rewarded myself for exercising (e.g. snack, watch TV, movies, buy gift, etc...).	1	2	3	4	5
39. I rewarded myself for reaching health goals related to exercise (e.g. improved fitness).	1	2	3	4	5
40. I rewarded myself for reaching appearance goals related to exercise (e.g. lose weight, tone body).	1	2	3	4	5
41. I punished myself for not exercising (e.g. withhold reward if I don't exercise).	1	2	3	4	5
42. When I exercised, I focused on how good I felt.	1	2	3	4	5
43. After I exercised, I focused on how good I felt.	1	2	3	4	5
44. I reminded myself of positive health benefits of exercise (e.g. reduced risk of chronic diseases).	1	2	3	4	5
45. I reminded myself of negative health consequences of not exercising (e.g. greater risk of disease).	1	2	3	4	5
46. I reminded myself of negative appearance consequences of not exercising (e.g. weight gain).	1	2	3	4	5
47. I mentally scheduled time periods to exercise.	1	2	3	4	5
48. I wrote down specific time periods to exercise.	1	2	3	4	5

	<u>Never</u>	<u>Rarely</u>	<u>Sometimes</u>	<u>Often</u>	<u>Very Often</u>
49. I rearranged my schedule of other activities to ensure I had time to exercise.	1	2	3	4	5
50. If I had conflicts with my scheduled time periods for exercise, I chose exercise.	1	2	3	4	5
51. I mentally noted barriers which influenced my ability to exercise.	1	2	3	4	5
52. I mentally planned ways to overcome barriers to my exercise activities.	1	2	3	4	5
53. I wrote down barriers which influenced my ability to exercise.	1	2	3	4	5
54. I wrote down ways to overcome barriers to my exercise activities.	1	2	3	4	5
55. I asked others to identify barriers to my exercise activities.	1	2	3	4	5
56. I purposely plan ways to exercise when I am on trips/vacations away from home.	1	2	3	4	5
57. I purposely planned ways to exercise during bad weather.	1	2	3	4	5

SOCIAL SUPPORT

Below is a list of things people might do or say to someone who is trying to exercise regularly.

Please rate each question ***TWICE***.

Under ***FAMILY***, rate how often anyone living in your household has said or done what is described during the last 3 months.

Under ***FRIENDS***, rate how often friends, co-workers, or acquaintances have said or done what is described during the last 3 months.

Please write ***one*** number from the following scale in each space:

	None	Rarely	A few times	Often	Very often
	1	2	3	4	5

During the past three months, my family (or members of my household) or friends:

	<u>FAMILY</u>	<u>FRIENDS</u>
58. Exercised with me.	_____	_____
59. Gave me encouragement to stick with my exercise program.	_____	_____
60. Changed their schedule so we could exercise together.	_____	_____
61. Offered to exercise with me.	_____	_____
62. Gave me helpful reminders to exercise.	_____	_____
63. Planned for exercise on recreational outings.	_____	_____
64. Discussed exercise with me.	_____	_____
65. Talked about how much they like to exercise.	_____	_____
66. Helped plan activities around my exercise.	_____	_____
67. Asked me for ideas on how they can get more exercise.	_____	_____
68. Complained about the time I spend exercising.	_____	_____
69. Criticized me or made fun of me for exercising.	_____	_____
70. Gave me rewards for exercising.	_____	_____
71. Took over chores so I had more time to exercise.	_____	_____
72. Made positive comments about my physical appearance.	_____	_____

OUTCOME EXPECTANCY VALUE

People often give many reasons or expected positive outcomes to why they engage in exercise activities. Listed below are common expected outcomes related to regular participation in exercise.

Using the following scale, circle the number next to each statement that best represents your level of agreement with each of the statements.

	<u>Strongly Disagree</u>	<u>Disagree</u>	<u>Neither Agree nor Disagree</u>	<u>Strongly Agree</u>	<u>Agree</u>
<i>Physical exercise will...</i>					
73. Help me to stay in shape.	1	2	3	4	5
74. Make me feel better in general.	1	2	3	4	5
75. Improve my health.	1	2	3	4	5
76. Help me maintain or lose weight.	1	2	3	4	5
77. Improve my physical attractiveness.	1	2	3	4	5
78. Enhance my self-image and confidence.	1	2	3	4	5
79. Have a positive psychological effect on me.	1	2	3	4	5
80. Will help me to reduce stress and relax.	1	2	3	4	5
81. Will give me a sense of accomplishment.	1	2	3	4	5
82. Will improve my mental alertness.	1	2	3	4	5
83. Allow me to have fun and enjoy activity.	1	2	3	4	5
84. Will help me cope with life's pressures.	1	2	3	4	5

APPENDIX F

Physical Activity Recall Measure

How much MODERATE exercise did you do in the last SEVEN DAYS?

MODERATE EXERCISE is physical activity done to enhance health/fitness that:

1. Mildly elevates your heart rate and breathing rate
2. You can hold a conversation during moderate exercise

Moderate Exercise Examples: Weight lifting, Resistance Training, Bicycling (less than 10 mph)
 Brisk walking, Hiking, Social dancing, Swimming (no laps)
 Golfing without cart, Doubles tennis
 Low impact exercise class (Yoga, Pilates, Tai Chi)
 Recreational team sports (volleyball, ½ court basketball, etc.)

DIRECTIONS:

1. **ACTIVITY COLUMN:** list the MODERATE exercises you did each day (example: walking).
2. **MINUTES COLUMN:** list the NUMBER OF MINUTES you did EACH moderate exercise.
3. **PLANNED COLUMN:** indicate if ACTIVITY is part of a regular, planned exercise program.

How much VIGOROUS exercise did you do in the last SEVEN DAYS?

	1. ACTIVITY (MODERATE EXERCISE)	2. Minutes	3. Planned
Sunday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Monday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Tuesday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Wednesday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Thursday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Friday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Saturday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no

VIGOROUS EXERCISE is physical activity done to enhance health/fitness that:

1. Produces significant increases in heart rate
2. Produces significant increases in breathing rate
3. Breathing rate makes it challenging to hold a conversation

Vigorous Exercise Examples: Running, High intensity aerobics exercise classes
 Competitive full field sports (soccer, lacrosse)
 Swimming laps, Cycling (10 mph or more)

DIRECTIONS:

1. **ACTIVITY COLUMN:** list the **VIGOROUS** exercises you did each day (example: running)
2. **MINUTES COLUMN:** list the **NUMBER OF MINUTES** you did **EACH** vigorous exercise.
3. **PLANNED COLUMN:** specify if **ACTIVITY** is part of a regular, planned exercise program.

	1. ACTIVITY (VIGOROUS EXERCISE)	2. MINUTES	3. Planned
Sunday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Monday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Tuesday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Wednesday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Thursday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Friday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no
Saturday	1. 2.	1. _____ minutes 2. _____ minutes	1. yes / no 2. yes /no

APPENDIX G

Participant Satisfaction and Perceived Quality of Life Questionnaires

Participant Satisfaction

	Treatment Group M ± SD (n=13)
1. I had fun in this program.	4.54 ± .519
2. The goal setting exercises were helpful in me reaching my goals.	4.69 ± .480
3. Knowing my target heart rate range kept me exercising at the right intensity	4.54 ± .519
4. Knowing the benefits of physical activity motivated me to keep exercising.	2.15 ± .376
5. Logging my exercise each week kept me accountable.	4.38 ± .506
6. Being in a group of people like me was less intimidating and made exercising more fun.	4.77 ± .439
7. Identifying my barriers to exercise and having strategies to overcome them was helpful.	3.08 ± .277
8. Understanding the FITT principle is important.	2.13 ± .480
9. I liked finding out what my comfort zone for exercise is.	4.62 ± .506
10. Finding time to exercise through time management strategies was helpful.	4.38 ± .506
11. The 8 weeks was long enough for this program.	4.77 ± .439
12. The amount of time spent in each strategy session was appropriate.	4.62 ± .506
13. Finding out my social support network was helpful.	4.54 ± .519
14. Seeking alternative methods for exercising was beneficial.	3.92 ± .760
15. Using the pedometer to keep track of my steps for 1 week fun and motivating.	4.77 ± .439
16. The nutrition session on sugar consumption was helpful in changing my dietary habits.	3.77 ± .439
17. This program met my expectations.	4.31 ± .480
18. I would recommend this program to others.	4.54 ± .519
19. The atmosphere of the program was positive and supportive.	4.92 ± .277

20. Setting long-term goals will help me to remain active.

4.77 ± .439

What could be changed about the program / additional comments?

“Really enjoyed the group dynamic”

“More lessons on nutrition”

“More nutrition”

“This was a great program”

“Exercise is not so scary anymore”

“Add more hands on experiences like the pedometer and less information”

Perceived Quality of Life

	Tx. Group M ± SD (n=13)	Control Group M ± SD (n=13)	<i>t</i>	Sig.
1. I am better able to control my weight.	4.00 ± 0.00	2.38 ± .650	8.954	.000*
2. I feel more energetic.	4.68 ± .480	2.46 ± .519	11.375	.000*
3. My mood is better.	2.54 ± .519	2.38 ± .650	.667	.511
4. My confidence to exercise regularly is improved.	4.62 ± .506	2.08 ± .277	15.853	.000*
5. I am eating more healthy foods.	2.92 ± .277	2.54 ± .776	1.682	.113
6. My sleep habits are improved.	2.31 ± .480	2.38 ± .506	-.397	.695
7. I feel more relaxed.	2.46 ± .519	2.38 ± .650	.333	.742
8. My stress level is reduced.	4.54 ± .519	2.23 ± .725	9.33	.000*
9. I'm more productive throughout the day.	4.46 ± .519	2.31 ± .480	10.983	.000*
10. Exercising is fun.	3.92 ± .641	1.77 ± .832	7.396	.000*

APPENDIX H

The Ohio State University IRB Forms

INITIAL REVIEW OF HUMAN SUBJECTS RESEARCH

The Ohio State University Institutional Review Boards

Office of Responsible Research Practices (ORRP)
300 Research Administration Building, 1960 Kenny Road, Columbus, OH 43210
Phone: (614) 688-8457 Fax: (614) 688-0366 orpp.osu.edu

IRB FORM #1000	DATE RECEIVED:	PROTOCOL NUMBER:
----------------------	----------------	------------------

1. PROJECT TITLE

The Promotion of Regular Exercise Behavior among Sedentary Emerging Adults based on Social Cognitive Theory

2. INSTITUTIONAL REVIEW BOARD

Select the Board to review this research:

Final Board assignment is determined by ORRP.

- Behavioral and Social Sciences
 Biomedical Sciences
 Cancer

3. PRINCIPAL INVESTIGATOR (or Advisor) - see [Qualifications for service as a PI](#)

Name (Last, First, MI):	Focht, Brian C.	Degree(s):	PhD
University Academic Title:	Associate Professor	College (TIU):	Education and Human Ecology
Department Name (TIU):	Kinesiology	Department # (TIU):	
Campus Mailing Address:	PAES Building 305 West 17 th Avenue	University ID Number:	
E-mail:	bfocht@ehs.osu.edu	Fax:	614-688-3432
Phone:	614-292-2165	Emergency phone:	

4. CO-INVESTIGATOR(S)

Are there any Ohio State University co-investigators on this protocol?

- Yes → Complete [Appendix A1](#)
 No

Signatures of co-investigator(s) are required on Appendix A1.

5. KEY PERSONNEL

Are there any Ohio State University key personnel on this protocol?

- Yes → Complete [Appendix A1](#)
 No

Key personnel are defined as individuals who participate in the design, conduct, or reporting of human subjects research. At a minimum, include individuals who recruit participants, obtain consent, or who collect study data.

6. EXTERNAL CO-INVESTIGATOR(S) & KEY PERSONNEL

Are any external (non-Ohio State University) investigators or key personnel *engaged* in the Ohio State research?

- Yes
 No → Go to Question #7

"Engaged" individuals are those who intervene or interact with participants in the context of the research or who will obtain individually identifiable private information for research funded, supervised, or coordinated by Ohio State University. See [OHRP Engagement Guidance](#) or contact ORRP for more information.

If Yes → Who will provide approval for these external personnel?

- Ohio State University IRB → Complete [Appendix A2](#)
 Non-Ohio State University IRB → *Provide a copy of the approval(s)*

7. ADDITIONAL CONTACT(S)

If further information about this application is needed, specify the contact person(s) if other than the PI (e.g., study or regulatory coordinator, research assistant, etc.). N/A

Name (Last, First, MI): Wirick, Steve, E Phone: 330-471-8295
 E-mail: Wirick.17@buckeyemail.osu.edu Fax: 330-471-8371
swirick@malone.edu

Name (Last, First, MI): Phone:
 E-mail: Fax:

All Ohio State University individuals listed on this protocol will have access to information about IRB actions and the completion status of each individual's administrative and training requirements (CITI, COI disclosure). Personal financial information provided in COI disclosures is not included.

8. EDUCATION

Educational requirements (initial and continuing) must be satisfied prior to submitting the application for IRB review. See [Human Subjects Protection Training](#) or contact ORRP for more information.

Have all Ohio State University investigators and key personnel completed the required web-based course (CITI) in the protection of human research subjects? Yes No

9. FINANCIAL CONFLICT OF INTEREST

All Ohio State University investigators and key personnel must have a current COI disclosure (updated as necessary for the proposed research) before IRB review. Examples of financial interests that must be disclosed include (but are not limited to) consulting fees or honoraria; stocks, stock options or other ownership interests; and patents, copyrights and royalties from such rights. For more information, see Office of Research Compliance [COI Overview](#) and [eCOI](#).

- a. Have all Ohio State University investigators and key personnel completed the required COI disclosure? Yes No
- b. Does any Ohio State University investigator (including principal or co-investigator), key personnel, or their immediate family members have a financial interest (including salary or other payments for services, equity interests, or intellectual property rights) that would reasonably appear to be affected by the research, or a financial interest in any entity whose financial interest would reasonably appear to be affected by the research? Yes No

10. FUNDING OR OTHER SUPPORT

If the research is federally funded and involves a subcontract to or from another entity, an IRB Authorization Agreement may be required. Contact ORRP for more information.

a. Is the research funded or has funding been requested? Yes No

If Yes → Specify sponsor: _____

Provide a copy of the grant application or funding proposal. The university is required to verify that all funding proposals and grants (new or renewals) have been reviewed by the IRB before funds are awarded.

b. Is any support other than monetary (e.g., drugs, equipment, etc.) being provided for the study? Yes No

If Yes → Specify support and provider: _____

11. OTHER INSTITUTIONAL APPROVALS

Check all that apply and provide applicable documentation. *See websites listed below for information on obtaining approvals. IRB review cannot be conducted until required institutional approvals or exemptions are obtained, except as noted.*

- None**
- Clinical Research Center (CRC) Scientific Advisory Committee (SAC)** – Approval required for research sponsored by the CRC. Final IRB approval will be held pending receipt of SAC approval.
- Institutional Biosafety Committee (IBC)** – Approval required for research involving biohazards (recombinant DNA, infectious or select agents, toxins), gene transfer, or xenotransplantation.
- Comprehensive Cancer Center (CCC) Clinical Scientific Review Committee (CSRC)** – Approval or exemption required for cancer-related research.
- Maternal-Fetal Welfare Committee** – Approval required for some research involving pregnant women and fetuses.
- Human Subject Radiation Committee (HSRC)** – Approval required for research involving radiologic procedures for research purposes (e.g., non-clinical care X-rays, DEXA or CT scans, nuclear medicine procedures, etc.).

12. LOCATION OF THE RESEARCH

Research to be conducted at locations other than approved performance sites will minimally require a letter of support and may require another IRB's approval if personnel are engaged. See [OHRP Engagement Guidance](#) or contact ORRP for more information.

a. List the specific site(s) at which the Ohio State research will be conducted (include both domestic and international locations).

Location Name (or description)	Address (street, city and state, or country)
Malone University – Wellness Center	2600 Cleveland Ave. NW, Canton, OH

- b. Are all the sites named above on the [Ohio State list of approved research performance sites](#)?
 - Yes
 - No

If No → Domestic sites → *Provide a letter of support, as applicable*
 International sites → Complete **Appendix U**
- c. Is the Ohio State PI the lead investigator or is The Ohio State University the lead site for collaborative research?
 - Yes
 - No → Go to **Question #13**
 - Not collaborative research → Go to **Question #13**
 - i. Describe the communication between sites that might be relevant to the protection of participants, such as unanticipated problems, interim results, and protocol modifications.
 The co-investigator (Steve Wirick) will communicate on a regular basis via phone and email with the PI (Brian Focht) throughout the study to discuss any unanticipated problems or protocol modifications.
 - ii. Describe IRB oversight arrangements for each collaborative site (i.e., who will provide IRB review and approval). *Provide copies of the non-Ohio State approvals, as applicable. Contact ORRP if requesting that Ohio State University serve as the IRB of record.*

While this research study is being initiated by OSU, Malone University will be the site at which the research takes place, therefore copies of the Malone University IRB approval is forthcoming. This research study will **NOT** be conducted in the context of Mr. Steve Wirick's academic appointment at Malone University. All aspects of this study will be conducted on the campus of Malone University. The exercise program will take place within the Wellness Center while the paper-and-pencil questionnaires and BOD POD assessment will be conducted in Timken Science Hall, room 231. Malone University's IRB approval will be forwarded on to OSU IRB.

13. EXPEDITED REVIEW

Are you requesting Expedited Review?

 Yes → Complete **Appendix B** No**14. SUMMARY OF THE RESEARCH**

Summarize the proposed research using *non-technical* language that can be readily understood by someone outside the discipline. Explain briefly the research design, procedures to be used, risks and anticipated benefits, and the importance of the knowledge that may reasonably be expected to result. *Use complete sentences (limit 300 words).*

In the landmark report *Physical Activity and Health: A Report of the Surgeon General* (USDHHS, 1996) a scientific consensus was reached on the benefits of physical activity on overall mortality, CVD, Type 2 diabetes, cancer, obesity, mental health, quality of life, risk of sudden death and musculoskeletal injury, osteoarthritis and bone health. Based on a review of literature conducted on emerging adults and physical activity behavior it is clear more research is needed. Yet to be identified in the literature is a thorough investigation of the non-university emerging adult with respect to physical activity behavior and of the few interventions that have been conducted with college students, evidence is insufficient to establish their effectiveness. This study will represent previously sedentary emerging adults aged 18-25 who will participate in an 8-week SCT-based behavioral and exercise program with two follow-up measures at 4 weeks and 8 weeks post program. Guided by Social Cognitive Theory this program will target the psychosocial constructs of exercise self-efficacy, social support, self-regulation, and outcome expectancy value as these have demonstrated consistent correlations with exercise behavior among this population. The exercise protocol for the treatment group will consist of an 8-week tapering program consisting of cardiovascular conditioning and resistance exercises. The treatment group will also participate in SCT-based group behavioral management strategy sessions which focus on developing behaviorally based approaches to increasing exercise self-efficacy, incorporating self-regulation techniques, building a social support network, and raising outcome expectancy value. The standard care group will receive what is typically offered to those individuals who join a local fitness/wellness center. There are no risks anticipated for either group during participation in this study. It is anticipated that participants will obtain health related benefits through participation in regular physical exercise and developing behavioral strategies that will enhance long-term adherence to planned physical exercise.

15. SCIENTIFIC BACKGROUND & LITERATURE REVIEW

Summarize existing knowledge and previous work that support the expectation of obtaining useful results without undue risk to human subjects. *Use complete sentences (limit 300 words).*

According to data reported by the CDC in 2007 using the Behavioral Risk Factor Surveillance Survey, only 48.8% of U.S. adults are achieving recommended amounts of physical activity. This data is cause for concern with more than 50% of U.S. adults classified as insufficiently active despite the scientific evidence of the overall benefits of maintaining a physically active lifestyle. While rates of physical activity are known to decline with age, the greatest reduction occurs during adolescence with a lowered sustained rate during young adulthood as this population is matriculating into family and work roles or continuing into higher education (Casperen et al., 2000). As the rate of physical activity declines with age an inverse relationship with obesity rate exists. According to 2006 data from the CDC utilizing the BRFSS, trends in the prevalence of obesity among U.S. adults aged 18 and older had increased to 34% (Ford and Mokdad, 2008) and continued to rise to 35.7% in 2009-2010 (Ogden et al., 2012). The CDC reports that in 2008 medical costs associated with obesity related diseases are estimated at \$147 billion dollars. This inverse relationship between physical activity and obesity rates is a recipe for economic disaster and poses serious repercussions regarding the future health and stability of nations. The most recent Position Stand by the ACSM indicates that in order to prevent weight gain 150 – 250 minutes per week of moderate intensity physical activity is necessary and for weight loss, greater than 250 minutes per week may be required coupled with moderate diet restriction (Donnelly et al., 2009). In a systematic review of the effectiveness of interventions to increase physical activity, Kahn et al. (2002) reported that theory-based programs demonstrate strong evidence in increasing physical activity rates provided the intervention is designed appropriately for the target population.

16. RESEARCH OBJECTIVES

List the specific scientific or scholarly aims of the research study.

Primary goal:

An evaluation of the impact of an 8-week SCT-based behavioral and exercise program on emerging adults compared to a standard care group on planned physical exercise rates and the SCT constructs of exercise self-efficacy, self-regulation, social support, and outcome expectancy.

Secondary goals:

To examine the relationship of the targeted SCT variables of exercise self-efficacy, self-regulation, social support, and outcome expectancy and changes in planned physical exercise behavior.

- o Investigate which SCT constructs better predict physical exercise behavior
- o Examine the mediating effects of those SCT constructs that significantly predict physical exercise behavior

17. RESEARCH METHODS & ACTIVITIES

- a. Identify and describe all interventions and interactions that are to be performed solely for the research study. Distinguish research (i.e., experimental) activities from non-research activities. *Provide description (e.g., spreadsheet or forms) of data being collected. Do not include case report forms for multi-site industry-sponsored or cooperative group studies.*

The target subjects for this study are those sedentary emerging adults aged 18-25 who are no longer attending high school and have not been participating in a regular planned exercise routine for the past 30 days; defined as exercising less than 30 minutes per week. Participants will be actively recruited via flyers posted at various merchant locations employing a high percentage of emerging adults (i.e. retail stores, restaurants, factories) and asking permission from the supervisor/manager to post recruitment flyers at the workplace. Additionally the Co-Investigator will visit area churches and ask church leaders for permission to post recruitment flyers in high pedestrian traffic buildings. Exclusion criteria will involve those participants who have participated in a regular exercise program the past 30 days; are a member of an athletic team or athletic club; are currently enrolled full-time in a 4 year college/university or 2 year community college; live on a university/college campus in a residence hall; are pregnant, plan to become pregnant; have any known contraindication to physical activity or exercise; do not meet the age requirement of 18-25; or fail to pass the Physical Activity Readiness Questionnaire (PAR-Q). Interested participants will be instructed to contact the Co-Investigator (Steve Wirick) via email or phone for additional information and determination of eligibility. Upon initial contact, the investigator will determine participant's eligibility by conducting a screening interview asking questions pertaining to the inclusion criteria. After initial eligibility status has been determined a baseline evaluation will be scheduled at which point a signed consent form and PAR-Q will be obtained. The participants will be randomly assigned to either the treatment group or the standard care group and then complete baseline assessments of the SCT questionnaire, physical exercise behavior measure, and fitness measures. At the conclusion of the study, those participants randomly assigned to the standard care group will be offered the packet of information that is used for the treatment group which describes the SCT-based group behavioral management strategy sessions.

The exercise protocol for the treatment group will consist of an 8-week exercise transition program consisting of cardiovascular conditioning and resistance training exercises. The exercise transition program is designed for the participant to understand and experience physiological and psychological response to exercise within a controlled setting and then begin to transition out of a controlled exercise setting into an exercise routine that is conducive to their unique and specific environment. During each supervised exercise session participants will begin with a 5-minute cardiovascular warm-up followed by a 25-minute total body resistance training circuit, then 25-minutes of aerobic exercise with their choice of using a treadmill, elliptical trainer, stationary bicycle, stair climber, or rower, and finishing with a 5-minute cool down incorporating flexibility exercises. During the aerobic exercise, participants will wear a heart rate monitor (Polar FT4, Polar Electro Inc., NY) with the target heart rate zone set between 50% and 85% of the participants' heart rate reserve (ACSM's Guidelines for Exercise Testing and Prescription, 7th ed.). Participants will be encouraged to remain in this zone for at least 20 minutes of the aerobic exercise session. Additionally, the treatment group will participate in weekly (for a total of 8) SCT-based group behavioral management strategy sessions. These 60-minute sessions will target those SCT constructs under investigation in this study. The focus will be on developing behaviorally based approaches to increasing exercise self-efficacy, incorporating self-regulation techniques, building a social support network, and raising outcome expectancy value. The standard care group receives an orientation to the Malone University Wellness Center, fitness and body composition assessment, exercise prescription adhering to ACSM guidelines for exercise for apparently healthy adults, and free access to the Malone University Wellness Center during normal hours of operation for the initial 8-weeks of the study.

The protocol for measurement will involve 4 assessments conducted over the duration of the study (baseline-A1, post-test at 8 weeks-A2, follow-up at 12 weeks-A3, and second follow-up at 16 weeks-A4). At baseline participants will complete a series of questionnaires intended to assess the following: (1) demographic data (gender, ethnicity, age, and university status); (2) physical activity readiness by completing the PAR-Q (revised, 2002); (3) psychosocial mediators of exercise from SCT that will include exercise self-efficacy, self-regulation, social support, and outcome expectancy value; and (4) current exercise behavior rate. Body composition will be determined via the BOD POD®; aerobic fitness through the 1-mile Rockport Walking test; and upper body muscular endurance via a push-up test. At assessments A2 and A3, the SCT questionnaires; exercise behavior rate questionnaire; and fitness measures will be completed. At assessment A4 (16-weeks, 2nd follow-up) participants will again complete the SCT questionnaires; exercise behavior rate questionnaire; fitness measures; and body composition assessment.

Physical exercise behavior measure:

- o 7dPAR – seven day physical activity recall (Petosa, 1993)

Social Cognitive Theory assessments:

- o Self-efficacy for exercise questionnaire (Garcia, A. & King, A. C., 1991)
- o Self regulation of exercise strategies (Petosa, P. S., 1993)
- o Social support and exercise survey (Sallis et al., 1987)
- o Outcome expectancy value for exercise (Steinhardt, M. A., & Dishman, R. K., 1989)

Fitness measures:

- o Body composition via the BOD POD®
- o Aerobic capacity via 1-mile Rockport Walking test
- o Upper body muscular endurance via push-up test

b. Check all research activities that apply:

- | | |
|---|---|
| <input type="checkbox"/> Anesthesia (general or local) or sedation | <input type="checkbox"/> Magnetic Resonance Imaging (MRI) |
| <input type="checkbox"/> Audio, video, digital, or image recordings | <input type="checkbox"/> Materials that may be considered sensitive, offensive, threatening, or degrading |
| <input type="checkbox"/> Biohazards (e.g., rDNA, infectious agents, select agents, toxins) | <input checked="" type="checkbox"/> Non-invasive medical procedures (e.g., EKG, Doppler) |
| <input type="checkbox"/> Biological sampling (other than blood) | <input type="checkbox"/> Observation of participants (including field notes) |
| <input type="checkbox"/> Blood drawing | <input type="checkbox"/> Oral history (does not include medical history) |
| <input type="checkbox"/> Coordinating Center | <input type="checkbox"/> Placebo |
| <input checked="" type="checkbox"/> Data, not publicly available | <input type="checkbox"/> Pregnancy testing |
| <input type="checkbox"/> Data, publicly available | <input type="checkbox"/> Program Protocol (Umbrella Protocol) |
| <input type="checkbox"/> Data repositories → Complete Appendix C
(future unspecified use, including research databases) | <input type="checkbox"/> Radiation (e.g., CT or DEXA scans, X-rays, nuclear medicine procedures) → Complete Appendix V |
| <input type="checkbox"/> Deception → Complete Appendix D & Appendix M1 | <input checked="" type="checkbox"/> Randomization |
| <input type="checkbox"/> Devices → Complete Appendix E | <input type="checkbox"/> Record review (which may include PHI) |
| <input checked="" type="checkbox"/> Diet, exercise, or sleep modifications | <input type="checkbox"/> Specimen research |
| <input type="checkbox"/> Drugs or biologics → Complete Appendix F | <input type="checkbox"/> Stem cell research |
| <input type="checkbox"/> Emergency research | <input type="checkbox"/> Storage of biological materials → Complete Appendix H
(future unspecified use, including repositories) |
| <input type="checkbox"/> Focus groups | <input type="checkbox"/> Surgical procedures (including biopsies) |
| <input type="checkbox"/> Food supplements | <input checked="" type="checkbox"/> Surveys, questionnaires, or interviews (one-on-one) |
| <input type="checkbox"/> Gene transfer | <input type="checkbox"/> Surveys, questionnaires, or interviews (group) |
| <input type="checkbox"/> Genetic testing → Complete Appendix G | <input type="checkbox"/> Other |
| <input type="checkbox"/> Internet or e-mail data collection | Specify: _____ |

18. DURATION

Estimate the time required from each participant, including individual interactions, total time commitment, and long-term follow-up, if any.

Treatment group: TOTAL TIME REQUIREMENT = 1510 minutes / 60 = approximately 25 hours

- Screening interview via phone or email: 10 minutes
- SCT behavioral sessions: 8 X 60 minutes = 480 minutes
- Supervised exercise sessions: 12 X 60 minutes = 720 minutes
- Baseline, post-test, 4-week follow-up, 8 week follow-up: 4 X 75 minutes = 300 minutes

Standard Care Group: TOTAL TIME REQUIREMENT = 310 minutes / 60 = approximately 5 hours

- Screening interview via phone or email: 10 minutes
- Baseline, post-test, 4-week follow-up, 8 week follow-up: 4 X 75 minutes = 300 minutes

19. NUMBER OF PARTICIPANTS

The number of participants is defined as the number of individuals who agree to participate (i.e., those who provide consent or whose records are accessed, etc.) even if all do not prove eligible or complete the study. The total number of research participants may be increased only with prior IRB approval.

- a. Provide the total number of participants (or number of participant records, specimens, etc.) for whom you are seeking Ohio State University IRB approval. 86
- b. Explain how this number was derived (e.g., statistical rationale, attrition rate, etc.).

In order to examine the treatment effects on the psychosocial constructs and exercise behavior of this 8-week Social Cognitive Theory based exercise program an appropriate sample size of 36 per group has been determined. This number of participants will provide adequate power which demonstrates a strong level of confidence in the statistical results and controls for Type II error; the failure to detect a difference when one does exist. In the behavioral sciences Cohen (1988) suggests a power of 0.80 which will be the criterion for this study. Effect size or the practical significance of the study must also be considered in order to demonstrate the magnitude of difference between the treatment and control group. Cohen (1992) recommends for the behavioral sciences a low to moderate effect size of $f = 0.20$ which is the established effect size for this study. The alpha level or level of risk the researcher is willing to take that the results may occur by chance (Type I error) will be set *a priori* at 0.05 which is common practice in physical activity behavior research. As we desire to reject the null hypothesis that no difference exists between the treatment and control groups in favor of the alternative hypothesis that the SCT constructs under study will impact physical activity behavior, a one-tailed directional hypothesis will be utilized. Considering these factors of power = 0.80, an effect size of 0.20, an alpha level set at 0.05, and the one-tailed direction of the alternative hypothesis, the appropriate sample size was determined using the computer software package G* Power 3 (Faul et al., 2007) for an ANOVA repeated measures two-factor design. Adjusting for a possible 20% attrition rate increases the total number of participants sought by 14 thus bringing the total number of participants sought to 86.

- c. Is this a multi-site study? Yes → Indicate the total number of participants to be enrolled across all sites: _____
 No

20. PARTICIPANT POPULATION

- a. Specify the age(s) of the individuals who may participate in the research:

Age(s): 18-25

- b. Specify the participant population(s). Check all that apply:

- | | |
|---|---|
| <input checked="" type="checkbox"/> Adults | <input type="checkbox"/> Pregnant women/fetuses → Complete Appendix K
<i>Do not complete Appendix K unless pregnant women will be intentionally recruited and/or studied.</i> |
| <input type="checkbox"/> Children (< 18 years) → Complete Appendix I | <input type="checkbox"/> Neonates (uncertain viability/nonviable) → Complete Appendix K |
| <input type="checkbox"/> Adults with decisional impairment → Complete Appendix W | <input type="checkbox"/> Prisoners → Complete Appendix L |
| <input type="checkbox"/> Non-English speaking → Complete Appendix J | <input type="checkbox"/> Unknown (e.g., secondary use of data/specimens, non-targeted surveys, program protocols) |
| <input type="checkbox"/> Student research pools (e.g., psychology, linguistics) | |
- Specify: _____

- c. Describe the characteristics of the proposed participants, and explain how the nature of the research requires/justifies their inclusion.

The characteristics of the proposed participants in this study are apparently healthy previously sedentary emerging adults aged 18-25. As described by Arnett (2000) emerging adulthood is neither adolescence nor young adulthood but a distinct time frame focusing on ages 18-25 of semi-autonomy with independent exploration and possibility while much of the future remains yet undecided. Inclusion of emerging adults in this study is supported by the desire to better understand what factors influence this population's physical exercise behavior as they are undergoing a transition phase of life from adolescence to adulthood and may present a pivotal time point when lasting health

behavior patterns are established. Both populations of those who attend university and those who do not attend university are considered emerging adults and it is the latter that is poorly under-represented in the literature and thus is the focused population in this study.

- d. Will any participants be excluded based on age, gender, race/ethnicity, pregnancy status, language, education, or financial status? Yes
 No

If Yes → Explain the criteria and reason(s) for each exclusion. *Consider the study's scientific or scholarly aims and risks.*

- Age: this study is focused on emerging adults defined as age 18-25 years
- Previously sedentary: focus of study is to increase physical exercise rates
- Non-member of athletic team or club: this would violate previously sedentary criterion
- Apparently healthy: participants need to pass the PAR-Q which recognizes contraindications to exercise participation
- English speaking: all discussions, instructions, and written materials will be conducted in English
- Availability: treatment group participants must be willing and available to meet for the scheduled SCT behavioral sessions and exercise sessions for the 8-week study along with a commitment to return for both follow-up measures at 4 and 8 weeks respectively
- Not being pregnant or not planning to become pregnant: physical exercise may be contraindicated for pregnant women thus will be excluded from the study
- Participants will NOT be excluded from the study based on gender, race/ethnicity, or financial status
- Not currently enrolled full-time in a 4 year university/college or 2 year community college
- Not currently live on a university/college campus in a residence hall

- e. Are any of the participants likely to be vulnerable to coercion or undue influence? *Consider students, employees, terminally ill persons, or others who may have limited autonomy.* Yes
 No

If Yes → Describe additional safeguards to protect participants' rights and welfare. *Consider strategies to ensure voluntary participation.*

21. PARTICIPANT IDENTIFICATION, RECRUITMENT, & SELECTION

- a. Provide evidence that you will be able to recruit the necessary number of participants to complete the study.

Two subsets of the adult population include college students who represent approximately 20.4 million students enrolled in higher education institutions in the U.S. (NCES, 2009) and those emerging adults who transition into the labor force upon high school graduation. According to the American College Health Association National College Health Assessment II Reference Group Executive Summary – Fall 2011, 52.6% of college students were not meeting physical activity guidelines for adults. From this same report, overweight/obesity rates for college students based on body mass index were 24.42%. Kasperek et al. (2008) demonstrated that those students who entered college with a BMI greater than 25 gained two times as much weight as those with a healthy BMI emphasizing the need for interventions targeting at-risk groups. According to the United States Department of Labor Bureau of Labor Statistics, 15.9 million persons age 16 to 24 were not enrolled in school as of October, 2011. In 2010 the National Center for Education Statistics reported that 7.9 million persons were enrolled in higher education part-time. Based on this data it is anticipated that recruitment of the appropriate number of participants will be obtained.

- b. Describe how potential participants will be identified (e.g., advertising, individuals known to investigator, record review, etc.). Explain how investigator(s) will gain access to this population, as applicable.

Potential participants will be identified by the Co-Investigator (Steve Wirick) visiting merchant locations that employ a high percentage of emerging adults (i.e. retail stores, restaurants, factories) and asking permission from the supervisor/manager to post recruitment flyers at the workplace. Additionally the Co-Investigator will visit area churches and ask church leaders for permission to post recruitment flyers in high pedestrian traffic buildings.

- c. List the names of investigator(s) and/or key personnel who will recruit participants.

Steve Wirick, Co-Investigator

- d. Describe the process that will be used to determine participant eligibility.

Interested participants will be instructed to contact the co-investigator (Steve Wirick) via email or phone for additional information and determination of eligibility. Upon initial contact, the investigator will determine participant's eligibility by conducting a screening interview asking questions pertaining to the inclusion criteria. The information obtained during the screening interview will be kept confidential.

- e. Describe the recruitment process; including the setting in which recruitment will take place. *Provide copies of proposed recruitment materials (e.g., ads, flyers, website postings, recruitment letters, and oral/written scripts).*

Recruitment will be conducted within the surrounding Canton, OH community. Participants will be actively recruited via flyers posted at various merchant locations employing a high percentage of emerging adults (i.e. retail stores, restaurants, factories) and asking permission from the supervisor/manager to post recruitment flyers at the workplace. Additionally the Co-Investigator will visit area churches and ask church leaders for permission to post recruitment flyers in high pedestrian traffic buildings. Interested participants will be instructed to contact the co-investigator (Steve Wirick) via email or phone for additional information and determination of eligibility. Upon initial contact, the investigator will determine participant's eligibility by conducting a screening interview asking questions pertaining to the inclusion criteria. Once eligibility status is obtained participants will schedule their baseline evaluation.

- f. Explain how the process respects potential participants' privacy.

All potential participants will be volunteers and all information obtained will be kept confidential. Participants will be reminded that they may ask as many questions as they would like and that they may withdraw from the study at any time.

22. INCENTIVES TO PARTICIPATE

Will participants receive compensation or other incentives (e.g., free services, cash payments, gift certificates, parking, classroom credit, travel reimbursement) to participate in the research study? *Compensation plans should be pro-rated (not contingent upon study completion) and should consider participant withdrawals, as applicable.*

- Yes
- No

If Yes → Describe the incentive, including the amount and timing of all payments.

In reference to 6e of the policy regarding recruiting methods, recruiting materials, and participant compensation for research bullet point number 4, "Any amount paid as a bonus for completion is reasonable and not so large as to unduly induce participants to stay in a study when they would otherwise have withdrawn", we are proposing that participants who complete the follow-up measures at assessment 4 be entered into a drawing to receive for free 1 of 10 new Polar FT4 heart rate monitors.

23. ALTERNATIVES TO STUDY PARTICIPATION

Other than choosing not to participate, list any specific alternatives, including available procedures or treatments that may be advantageous to the subject.

If a participant chooses not to participate, withdraws from the study, or does not meet inclusion criteria, a general exercise guideline sheet from the ACSM will be provided along with a list of potential fitness/exercise centers in the surrounding area.

24. INFORMED CONSENT PROCESS

Indicate the consent process(es) and document(s) to be used in the study. Check all that apply. *Provide copies of documents and/or complete relevant appendices, as needed. See [Consent for Research for templates](#), [HRPP policies](#) [Informed Consent Process and the Elements of Informed Consent](#), [Documentation of the Informed Consent Process](#), and [Assent and Parental Permission](#) or contact [ORRP](#) for more information.*

- | | |
|--|---|
| <input type="checkbox"/> Assent – Form | <input type="checkbox"/> Parental Permission – Form |
| <input type="checkbox"/> Assent – Verbal Script | <input type="checkbox"/> Parental Permission – Verbal Script → Complete Appendix M2 |
| <input checked="" type="checkbox"/> Informed Consent – Form | <input type="checkbox"/> Translated Consent/Assent – Form(s) → Complete Appendix J |
| <input type="checkbox"/> Informed Consent – Verbal Script → Complete Appendix M2 | <input type="checkbox"/> Waiver or Alteration of Consent Process → Complete Appendix M1 |
| <input type="checkbox"/> Informed Consent – Addendum | <input type="checkbox"/> Waiver of Consent Documentation → Complete Appendix M2 |

- b. List the names of investigator(s) and/or key personnel who will obtain consent from participants or their legally authorized representatives. N/A

Steve Wirick, Co-Investigator

- c. Who will provide consent or permission (i.e. participant, legally authorized representative, parent and/or guardian)? N/A

Participants themselves will provide consent by signing the consent form.

- d. Describe the consent process. Explain when and where consent will be obtained and how subjects and/or their legally authorized representatives will be provided sufficient opportunity (e.g., waiting period, if any) to consider participation. N/A

An informed consent form will be administered to all participants who meet the eligibility criteria and have scheduled their baseline assessment. At the baseline assessment and prior to any data collection the participant will be afforded the opportunity to read and understand the consent form and have their questions answered to their satisfaction. They will decide then whether they wish to become a participant in this study and sign the consent form. The evaluation and signing of the consent form will be conducted in the Timken Science hall on the campus of Malone University in room 231 (a private office).

- e. Explain how the possibility of coercion or undue influence will be minimized in the consent process. N/A

After the participants have had an opportunity to read and understand the consent form and all their questions have been answered to their satisfaction, participants will be reminded that they may withdraw from the study at any time and that no other benefits aside from the potential health benefits of participating in the study are being offered thus minimizing undue influence or coercion.

- f. Will any other tools (e.g., quizzes, visual aids, information sheets) be used during the consent process to assist participant comprehension? Yes → *Provide copies of these tools*
 No

- g. Will any other consent forms be used (e.g., for clinical procedures such as MRI, surgery, etc. and/or consent forms from other institutions)? Yes → *Provide copies of these forms*
 No

25. PRIVACY OF PARTICIPANTS

- a. Describe the provisions to protect the privacy interests of the participants. *Consider the circumstances and nature of information to be obtained, taking into account factors (e.g., age, gender, ethnicity, education level, etc.) that may influence participants' expectations of privacy.*

An identification number will be assigned to each participant. An initial cover sheet will contain contact information relating to the participant and the ID number. This document will be kept separate from the other data collected and locked in a secure filing cabinet in which only the co-investigator has access to. Any and all data retrieved will be analyzed and filed by ID number only thus protecting the privacy of the participant. Only group data will be analyzed and presented further safeguarding the individual participant any risk of being personally identified.

- b. Does the research require access to personally identifiable private information? Yes
 No

If Yes → Describe the personally identifiable private information involved in the research. List the information source(s) (e.g., educational records, surveys, medical records, etc.).

26. CONFIDENTIALITY OF DATA

- a. Explain how information is handled, including storage, security measures (as necessary), and who will have access to the information. Include both electronic and hard copy records. *Methods for handling and storing data (including the use of personal computers and portable storage devices) must comply with university policies. For more information, see [Policy on Institutional Data](#) and [Research Data Policy](#).*

All electronic data collected will be stored on the co-investigator's encrypted personal computer. All hard copy materials will be stored in a locked file cabinet in which only the Co-Investigator (Steve Wirick) has access to. At the conclusion of analyzing the data all records of identification will be eliminated. It is anticipated that personal information will be stored for approximately 3 months after the conclusion of the last follow-up measure. During the initial screening process participants will be informed of how their individual confidentiality will be protected and how the data will be presented by group only.

- b. Explain if any personal or sensitive information that could be potentially damaging to participants (e.g., relating to illegal behaviors, alcohol or drug use, sexual attitudes, mental health, etc.) will be collected. N/A

- c. Will you be obtaining an NIH Certificate of Confidentiality? Yes → *Provide a copy before you begin the research*
 No

See [HRPP policy Privacy and Confidentiality](#) for more information.

- d. Explain any circumstances (ethical or legal) where it would be necessary to break confidentiality. N/A

- e. Indicate what will happen to identifiable data at the end of the study. *Primary research data should be retained for a minimum of five years after final project closeout. For more information, see the university's [Research Data Policy](#). Other research-related records should be retained for a period of at least three years after the research has been discontinued (i.e., no further data collection, long term follow-up, re-contact, or analysis of identifiable/coded data.)*

- Identifiable data were not collected
 Identifiers will be permanently removed from the data and destroyed (resulting in de-identified data)

- Identifiable or coded/linked data will be retained and stored securely (as appropriate)
- Identifiable data will be retained and may be made public with participant consent (e.g., ethnographic research)

27. HIPAA RESEARCH AUTHORIZATION

Will individually identifiable Protected Health Information (PHI) subject to the [HIPAA Privacy Rule](#) requirements be accessed, used, or disclosed in the research study?

- No
- Yes → Check all that apply:
 - Written Authorization → *Provide a copy of the Authorization Form*
 - Partial Waiver (recruitment purposes only) → Complete **Appendix N**
 - Full Waiver (entire research study) → Complete **Appendix N**
 - Alteration (written documentation) → Complete **Appendix N**

28. REASONABLY ANTICIPATED BENEFITS

- a. List the potential benefits that participants may expect as a result of this research study. State if there are no direct benefits to individual participants. *Compensation is not to be considered a benefit.*

As a result of this study participants can expect to have developed the skills necessary to continue exercising regularly which may bring about positive changes that impact their overall health.

- b. List the potential benefits that society and/or others may expect as a result of this research study.

Society's benefits as a result of this research study may involve the identification of a program that positively impacts the exercise behavior rates of emerging adults who are undergoing a significant transition phase of life where lasting behaviors are being developed. It may be possible then for physical activity behavior specialists and other health professionals to adopt these strategies for exercise promotion within their own environments.

29. RISKS, HARMS, & DISCOMFORTS

- a. Describe all reasonably expected risks, harms, and/or discomforts that may apply to the research. Discuss severity and likelihood of occurrence. As applicable, include potential risks to an embryo or fetus if a woman is or may become pregnant. *Consider the range of risks, including physical, psychological, social, legal, and economic.*

1) Risk: Physical

- a) Occurrence: Injury is unlikely as participants will be oriented to the operation of all exercise equipment in the Wellness Center and taught proper technique to ensure safety.
- b) Harm/discomforts: Any physical discomfort resulting from the exercise sessions may include mild muscle soreness which is typical when beginning any new exercise program. This soreness normally subsides within 2-3 days after an initial exercise session. The program will be such that time will be provided between bouts of exercise for proper muscle recovery. The 1-mile walk test and muscle endurance push-up test may also produce mild muscle soreness with the same recovery as previously described. There appears to be no long-term risks.

2) Risk: Psychological

- a) Occurrence: Psychological stress is unlikely
- b) Harm/discomforts: The nature of the questionnaires is such that very little personal information is divulged and relates more to subjective responses to factors that influence exercise behavior therefore minimizing any harms or discomforts in the short or long-term.

3) Risk: Social, Legal, Economic

- a) Occurrence: Unlikely
 b) Harm/discomforts: There seems to be minimal potential for any social, legal, or economic harm or discomfort

4) Risk: Compromise of Confidentiality

- a) Occurrence: Unlikely
 b) Harm/discomforts: If there would be a breach in confidentiality regarding participant demographic information or results from their assessments, it would seem plausible that do to the broad nature of information collected any harm or discomfort would be minimal.
 b. Describe how risks, harms, and/or discomforts will be minimized. *If testing will be performed to identify individuals who may be at increased risk (e.g., pregnant women, individuals with HIV/AIDS, depressive disorders, etc.), address timing and method of testing; include how positive test results will be handled.*

All participants will have passed the PAR-Q indicating they are apparently healthy and at minimal risk for adverse affects from exercising. To protect participants from discomfort or injury during the exercise sessions, adherence to ACSM guidelines for exercise and testing will be strictly followed. Participants will be taught and engage in proper warm-up, stretching, and cool-down techniques while also allowing for proper rest between sessions to allow for muscle soreness to dissipate. An Automated External Defibrillator is on-site in the Wellness Center.

All electronic data collected will be stored on the co-investigator's encrypted personal computer. All hard copy materials will be stored in a locked file cabinet in which only the Co-Investigator (Steve Wirick) has access to. At the conclusion of analyzing the data all records of identification will be eliminated. It is anticipated that personal information will be stored for approximately 3 months after the conclusion of the last follow-up measure. During the initial screening process participants will be informed of how their individual confidentiality will be protected and how the data will be presented by group only.

All potential participants will be volunteers and all information obtained will be kept confidential. Participants will be reminded that they may ask as many questions as they would like and that they may withdraw from the study at any time.

30. MONITORING

Does the research involve greater than minimal risk (i.e., are the harms or discomforts described in Question #29 beyond what is ordinarily encountered in daily life or during the performance of routine physical or psychological tests)? Yes No

If Yes → Describe the plan to oversee and monitor data collected to ensure participant safety and data integrity. Include the following:

- The information that will be evaluated (e.g., incidence and severity of actual harm compared to that expected);
- Who will perform the monitoring (e.g., investigator, sponsor, or independent monitoring committee);
- Timing of monitoring (e.g., at specific points in time, after a specific number of participants have been enrolled); and
- Decisions to be made as a result of the monitoring process (e.g., provisions to stop the study early for unanticipated problems).

31. ASSESSMENT OF RISKS & BENEFITS

Discuss how risks to participants are reasonable when compared to the anticipated benefits to participants (if any) and the importance of the knowledge that may reasonably be expected to result.

The anticipated benefits of participants developing the skills to becoming consistent exercisers long-term thus reducing their risk of developing CVD, Type 2 diabetes, cancer, obesity; while improving their mental health, quality of life, bone health; and further reducing their risk of sudden death, musculoskeletal injury, and osteoarthritis far outweigh any risks from participating in this study. As a result of the knowledge and skills gained from participating in this study, participants will have the tools to begin to lead a healthier lifestyle.

32. PARTICIPANT COSTS/REIMBURSEMENTS

- a. List any potential costs participants (or their insurers) will incur as a result of study participation (e.g., parking, study drugs, diagnostic tests, etc.).

Parking is free on the campus of Malone University except for reserved faculty/staff parking spaces so participants should not incur any parking fees and there is no cost for utilizing the Wellness Center.

- b. List any costs to participants that will be covered by the research study.
There are no costs to participants that will be covered by the research study.

33. APPLICATION CONTENTS

Indicate the documents being submitted for this research project. Check all appropriate boxes.

- Initial Review of Human Subjects Research Application**
- Appendix A1: Ohio State University Co-Investigators & Key Personnel (questions 4 & 5)
- Appendix A2: External (non-Ohio State) Co-Investigators & Key Personnel (question 6)
- Appendix B: Expedited Review – Initial Review (question 13)
- Appendix C: Data Repositories (question 17b)
- Appendix D: Deception (question 17b)
- Appendix E: Devices (question 17b)
- Appendix F: Drugs or Biologics (question 17b)
- Appendix G: Genetic Testing (question 17b)
- Appendix H: Storage of Biological Materials (question 17b)
- Appendix I: Children (question 20b)
- Appendix J: Non-English Speaking Participants (questions 20b and 24a)
- Appendix K: Pregnant Women/Fetuses/Neonates (question 20b)
- Appendix L: Prisoners (question 20b)
- Appendix M1: Waiver or Alteration of Consent Process (questions 17b & 24a)
- Appendix M2: Waiver of Consent Documentation (question 24a)
- Appendix N: Waiver or Alteration of HIPAA Research Authorization (question 27)
- Appendix U: Research in International Settings (question 12)
- Appendix V: Radiation (question 17b)
- Appendix W: Adults with Decisional Impairment (question 20b)
- Consent form(s), Assent Form(s), Permission Form(s), and Verbal Script(s), including translated documents (question 24a)
- HIPAA Research Authorization Form(s) (question 27)
- Data Collection Form(s) for Investigator-Initiated Studies (question 17a)
- Data Collection Form(s) involving protected health information (Appendix N)
- Recruitment Materials (e.g., ads, flyers, telephone or other oral script, radio/TV scripts, internet solicitations) (question 21d)
- Script(s) or Information Sheet(s), including Debriefing Materials (question 24)
- Instruments (e.g., questionnaires or surveys to be completed by participants) (question 17b)
- Other Committee Approvals/Letters of Support (questions 11 & 12)
- Research Protocol

- Complete Grant Application or Funding Proposal, as applicable
- Drug Manufacturer's Approved Labeling/Investigator's Drug Brochure (Appendix F)
- Device Manufacturer's Approved Labeling (Appendix E)
- Other supporting documentation and/or materials

For Multi-Site Clinical Trials supported by DHHS, the submission will also include:

- DHHS-approved Sample Informed Consent Document (if one exists)
- DHHS-approved Protocol (if one exists)

34. ASSURANCE

PRINCIPAL INVESTIGATOR (or Advisor)

I agree to follow all applicable federal regulations, guidance, state and local laws, and university policies related to the protection of human subjects in research, as well as professional practice standards and generally accepted good research practices for investigators, including, but not limited to, the responsibilities described in HRPP policy [Responsibilities of Principal Investigators, Co-Investigators and Key Personnel](#).

I verify that the information provided in this Initial Review of Human Subjects Research application is accurate and complete. I will initiate this research only after having received notification of final IRB approval.

Signature of Principal Investigator (or Advisor)

Date

Printed name of Principal Investigator (or Advisor)

DEPARTMENT CHAIR (or Signatory Official)

As Department Chair (or Signatory Official) for the Principal Investigator, I acknowledge that this research is in keeping with the standards set by our unit and that it has met all Departmental/College requirements for review.

If the PI or any co-investigator is also the Department Chair, the signature of the Dean or other appropriate Signatory Official, such as the Associate Dean for Research, must be obtained.

Signature of Department Chair

Date

Printed name of Department Chair



Biomedical Sciences Institutional Review Board

Office of Responsible Research Practices
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Columbus, OH 43210-1063

Phone (614) 688-8457
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March 13, 2013

Protocol Number: 2012H0423
Protocol Title: THE PROMOTION OF REGULAR EXERCISE BEHAVIOR AMONG SEDENTARY EMERGING ADULTS BASED ON SOCIAL COGNITIVE THEORY, Brian C. Focht, Stephen E. Wirick, School of Physical Activity and Education Services
Type of Review: Initial Review – expedited
IRB Staff Contact: Paul Montesanti
614.292.9804
Montesanti.2@osu.edu

Dear Dr. Focht,

The Biomedical Sciences IRB **APPROVED BY EXPEDITED REVIEW** the above referenced research. The Board was able to provide expedited approval under 45 CFR 46.110(b)(1) because the research meets the applicability criteria and one or more categories of research eligible for expedited review, as indicated below.

Date of IRB Approval: March 12, 2013
Date of IRB Approval Expiration: March 12, 2014
Expedited Review Category: 7

If applicable, informed consent (and HIPAA research authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. The IRB-approved consent form and process must be used. Changes in the research (e.g., recruitment procedures, advertisements, enrollment numbers, etc.) or informed consent process must be approved by the IRB before they are implemented (except where necessary to eliminate apparent immediate hazards to subjects).

This approval is valid for **one year** from the date of IRB review when approval is granted or modifications are required. The approval will no longer be in effect on the date listed above as the IRB expiration date. A Continuing Review application must be approved within this interval to avoid expiration of IRB approval and cessation of all research activities. A final report must be provided to the IRB and all records relating to the research (including signed consent forms) must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of all investigators and research staff to promptly report to the IRB any serious, unexpected and related adverse events and potential unanticipated problems involving risks to subjects or others.

This approval is issued under The Ohio State University's OHRP Federalwide Assurance #00006378. All forms and procedures can be found on the ORRP website – www.orrp.osu.edu. Please feel free to contact the IRB staff contact listed above with any questions or concerns.

Karla Zadnik, OD, PhD, Chair
Biomedical Sciences Institutional Review Board



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**The Ohio State University in Collaboration with Malone
University Consent to Participate in Research**

Study Title: The Promotion of Regular Exercise Behavior among Sedentary
Emerging Adults based on Social Cognitive Theory

Researcher: Principal Investigator: Brian Focht, PhD
Co-Investigator: Steve Wirick

Sponsor: N/A

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This is a consent form for research participation. It contains important information about
this study and what to expect if you decide to participate.

10

Your participation is voluntary.

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Please consider the information carefully. Feel free to ask questions before making your
decision whether or not to participate. If you decide to participate, you will be asked to sign
this form and will receive a copy of the form.

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Purpose:

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The purpose of this study is to examine the effects of an 8-week Social Cognitive Theory
based behavioral and exercise program designed to increase planned physical exercise among
emerging adults compared to a standard care group. Specifically, you are being asked to
participate in this study to see if the 8-week program influences your exercise patterns 8
weeks after the study is over.

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Procedures/Tasks:

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As a participant in this study you are being asked to increase your levels of planned exercise
over the course of the 8 week intervention and then on your own continue and/or increase
your planned exercise for another 8 weeks. During the study you will be assessed four times
by way of a series of paper and pencil questionnaires and some basic fitness measures. You
will not be audio or video taped during the study and any medical or educational records will
not be accessed by other parties. Your information will be kept strictly confidential.

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Following completion of the baseline assessment, you will be randomly assigned ("like
flipping a coin") to the standard care exercise group or the exercise behavioral management
strategies plus exercise group. The standard care exercise group receives the following:

- An orientation to the Malone University Wellness Center

- 34 • Unlimited access (normal operating hours) to the Wellness Center during the 8
- 35 week intervention
- 36 • Body composition assessment via the BOD POD® at the 16-week follow-up test if
- 37 participant desires
- 38 • Fitness assessment: Rockport walk test for aerobic capacity, push-up test for
- 39 upper-body muscular endurance
- 40 • Exercise program based on fitness testing results
- 41

42 The exercise behavioral management strategies plus exercise group receives the following:

- 43 • An orientation to the Malone University Wellness Center
- 44 • Unlimited access (normal operating hours) to the Wellness Center during the 8
- 45 week intervention
- 46 • Body composition assessment via the BOD POD® at the 16-week follow-up test if
- 47 participant desires
- 48 • Fitness assessment: Rockport walk test for aerobic capacity, push-up test for
- 49 upper-body muscular endurance
- 50 • Exercise program based on fitness testing results
- 51 • Supervised 60-minute exercise sessions in the Wellness Center starting at 3 times
- 52 per week during the first week and tapering over the next 7 weeks to a
- 53 transitioning out of the Wellness Center and into the participants own environment
- 54 • One 60-minute Social Cognitive Theory based exercise behavioral strategy lesson
- 55 per week for 8 weeks targeting factors that influence exercise rates
- 56

57 For the body composition assessment you will sit comfortably in a chamber breathing
58 normally for approximately one minute while the device estimates the amount of fat and lean
59 tissue in the body. Your body mass will be measured using the system's electronic scale. For
60 the Rockport walk test you will be instructed to walk one mile on a treadmill as quickly as
61 possible while wearing a heart rate monitor. At the completion of the one mile walk the
62 researcher will record your ending heart rate and the amount of time it took to complete the
63 walk. The push-up test will involve having you perform as many push-ups as you can in 8
64 without resting and with proper form. The researcher will count the number of push-ups
65 completed. The exercise behavior strategy sessions will focus on developing behaviorally
66 based approaches to increasing exercise confidence, incorporating self-management
67 techniques, building a social support network, and increasing the value placed on regular
68 exercise. The sessions will be split into thirds allowing for 20 minutes each spent in the
69 following categories: an introduction of the topic for the week using discussion/video/lecture;
70 in-class activities; and finishing with a discussion of opportunities for the upcoming week.
71 The supervised exercise sessions will begin with a 5-minute cardiovascular warm-up followed
72 by a 25-minute total body resistance training circuit, then 25-minutes of aerobic exercise with
73 their choice of using a treadmill, elliptical trainer, stationary bicycle, stair climber, or rower,
74 and finishing with a 5-minute cool down incorporating flexibility exercises. During the
75 aerobic exercise, you will wear a heart rate monitor with the target heart rate zone set between
76 50% and 85%. You will be encouraged to remain in this zone for at least 20 minutes of the
77 aerobic exercise session. The American College of Sports Medicine guidelines for exercise

78 and testing will be strictly adhered to for the safety of all during the fitness assessments and
79 supervised exercise sessions.
80

81
82 Listed below describes what you will be asked to complete for the study:

- 83 • **Baseline:**
84 ○ Questionnaires to determine current exercise behavior rates and social
85 cognitive factors
86 ○ Rockport walk test
87 ○ Push-up test
88
- 89 • **Post-test (end of 8 week study):**
90 ○ Questionnaires to determine current exercise behavior rates and social
91 cognitive factors
92 ○ Rockport walk test
93 ○ Push-up test
94
- 95 • **4-week follow-up:**
96 ○ Questionnaires to determine current exercise behavior rates and social
97 cognitive factors
98
- 99 • **8-week follow-up:**
100 ○ Questionnaires to determine current exercise behavior rates and social
101 cognitive factors
102 ○ Body composition assessment
103 ○ Rockport walk test
104 ○ Push-up test
105

106 **Duration:**

107 This study consists of 8 weeks of participation in exercise activities with 2 follow-up
108 assessments. During the course of the study you will be assessed 4 times. If you are assigned
109 to the standard care exercise group it is anticipated that the total time requirement over the 16
110 weeks will be approximately 5 hours. This includes a 10-minute eligibility screening
111 interview and the four assessment points of approximately 75 minutes each.
112

113 If you are in the exercise behavioral management strategies plus exercise group it is
114 anticipated that the total time requirement over the 16 weeks will be approximately 25 hours
115 and includes: a 10-minute eligibility screening interview; eight 60-minute exercise behavioral
116 strategy sessions; twelve 60-minute supervised exercise sessions; and the four assessment
117 points of approximately 75 minutes each.
118

119 You may leave the study at any time. If you decide to stop participating in the study, there
120 will be no penalty to you, and you will not lose any benefits to which you are otherwise
121 entitled. Your decision will not affect your future relationship with The Ohio State University
122 or Malone University.

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Risks:

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Any physical discomfort resulting from the exercise sessions may include mild muscle soreness which is typical when beginning any new exercise program. This soreness normally subsides within 2-3 days after an initial exercise session. The program will be such that time will be provided between bouts of exercise for proper muscle recovery. The 1-mile walk test and muscle endurance push-up test may also produce mild muscle soreness with the same recovery as previously described. Physical injury is unlikely as you will be oriented to the operation of all exercise equipment in the Wellness Center and taught proper technique to ensure safety. Psychological stress is unlikely as the nature of the questionnaires is such that very little personal information is divulged and relates more to subjective responses to factors that influence exercise behavior. There seems to be minimal potential for any social, legal, or economic risk.

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All participants will have passed the *Physical Activity Readiness Questionnaire* indicating they are apparently healthy and at minimal risk for adverse affects from exercising. To protect participants from discomfort or injury during the exercise sessions, adherence to ACSM guidelines for exercise and testing will be strictly followed. Participants will be taught and engage in proper warm-up, stretching, and cool-down techniques while also allowing for proper rest between sessions to allow for muscle soreness to dissipate. An Automated External Defibrillator is on-site in the Wellness Center. I have read the information about this study and agree that, to my knowledge, I am healthy enough to take part. I also agree to the following: that I will let the researcher know immediately if I experience any discomfort that I think might be associated with my participation in this exercise study, and that I agree that the question about any relationship between illness/ injury and my participation in this study would be a matter for deliberation and determination through appropriate legal proceedings.

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Benefits:

As a result of this study you can expect to have developed the skills necessary to continue exercising regularly which may bring about positive changes that impact your overall health. Society's benefits as a result of this research study may involve the identification of a program that positively impacts the exercise behavior rates of emerging adults who are undergoing a significant transition phase of life where lasting behaviors are being developed. It may be possible then for physical activity behavior specialists and other health professionals to adopt these strategies for exercise promotion within their own environments.

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Confidentiality:

You will be assigned an identification number for this study. An initial cover sheet will contain contact information linking you and the ID number. This document will be kept separate from the other data collected and locked in a secure filing cabinet in which only the co-investigator has access to. Any and all data retrieved will be analyzed and filed by ID number only thus protecting your privacy. Only group data will be analyzed and presented further safeguarding you from any risk of being personally identified. All electronic data collected will be stored on the co-investigator's encrypted personal computer. All hard copy

168 materials will be stored in a locked file cabinet in which only the Co-Investigator (Steve
169 Wirick) has access to. At the conclusion of analyzing the data all records of identification will
170 be eliminated. It is anticipated that personal information will be stored for approximately 3
171 months after the conclusion of the last follow-up measure.

172
173 Efforts will be made to keep your study-related information confidential. However, there may
174 be circumstances where this information must be released. For example, personal information
175 regarding your participation in this study may be disclosed if required by state law. Also,
176 your records may be reviewed by the following groups (as applicable to the research):

- 177 • Office for Human Research Protections or other federal, state, or international
178 regulatory agencies;
- 179 • The Ohio State University Institutional Review Board or Office of Responsible
180 Research Practices
- 181 • Malone University Human Research Committee/IRB
- 182 • The sponsor, if any, or agency (including the Food and Drug Administration for FDA-
183 regulated research) supporting the study.

184
185 **Incentives:**

186 Participants who complete the follow-up measures at assessment 4 will be entered into a
187 drawing to receive for free 1 of 10 new Polar FT4 heart rate monitors.

188
189 **Participant Rights:**

190 You do not give up any personal legal rights by agreeing to participate in this study. You may
191 refuse to participate in this study without penalty or loss of benefits to which you are
192 otherwise entitled. If you are a student or employee at Ohio State or Malone University, your
193 decision will not affect your grades or employment status.

194 If you choose to participate in the study, you may discontinue participation at any time
195 without penalty or loss of benefits. By signing this form, you do not give up any personal
196 legal rights you may have as a participant in this study.

197 An Institutional Review Board responsible for human subjects research at The Ohio State
198 University and Malone University reviewed this research project and found it to be
199 acceptable, according to applicable state and federal regulations and University policies
200 designed to protect the rights and welfare of participants in research.

201

202 **Contacts and Questions:**

203 For questions, concerns, or complaints about the study you may contact the Principal
204 Investigator Dr. Brian Focht at 614-292-2165, or the Co-investigator Steve Wirick at 330-
205 471-8295. For questions about your rights as a participant in this study or to discuss other
206 study-related concerns or complaints with someone who is not part of the research team, you
207 may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-
208 678-6251.

209

210 In addition, this study has been reviewed and approved by the Human Research
211 Committee/IRB at Malone University. If you have questions about this project, please, feel
212 free to contact the research supervisor. If you have questions about this study or about ethics

CONSENT
Behavioral/Social Science

IRB Protocol Number:
IRB Approval date:
Version:

213 in human research, then please, contact the Chair of the Human Research Committee,
214 Professor Lauren Seifert at LSEIFERT@malone.edu or at 330-471-8558.

215

216 In the event of an injury or illness sustained during an exercise session while on the campus of
217 Malone University within the Wellness Center, participants are to notify the Co-investigator
218 Steve Wirick who will be present during the supervised exercise sessions or notify the
219 Wellness Center staff.

220

221 Please provide the name and phone number of an emergency contact person that you are
222 authorizing the research staff to contact in the event of an illness or injury sustained during
223 the study.

224

225

226 _____
(Emergency Contact Person)

_____ (Phone Number)

227 **Signing the consent form**

228

229 I have read (or someone has read to me) this form and I am aware that I am being asked to
230 participate in a research study. I have had the opportunity to ask questions and have had them
231 answered to my satisfaction. I voluntarily agree to participate in this study.

232

233 I am not giving up any legal rights by signing this form. I will be given a copy of this form.

234

Printed name of subject

Signature of subject

Date and time

AM/PM

Printed name of person authorized to consent for subject
(when applicable)

Signature of person authorized to consent for subject
(when applicable)

Relationship to the subject

Date and time

AM/PM

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238 **Investigator/Research Staff**

239

240 I have explained the research to the participant or his/her representative before requesting the
241 signature(s) above. There are no blanks in this document. A copy of this form has been given
242 to the participant or his/her representative.

243

Printed name of person obtaining consent

Signature of person obtaining consent

Date and time

AM/PM

244



Biomedical Sciences Institutional Review Board

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300 Research Administration Building
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March 13, 2013

Protocol Number: 2012H0423
Protocol Title: THE PROMOTION OF REGULAR EXERCISE BEHAVIOR AMONG SEDENTARY EMERGING ADULTS BASED ON SOCIAL COGNITIVE THEORY, Brian C. Focht, Stephen E. Wirick, School of Physical Activity and Education Services
Type of Review: Initial Review – expedited
IRB Staff Contact: Paul Montesanti
614.292.9804
Montesanti.2@osu.edu

Dear Dr. Focht,

The Biomedical Sciences IRB **APPROVED BY EXPEDITED REVIEW** the above referenced research. The Board was able to provide expedited approval under 45 CFR 46.110(b)(1) because the research meets the applicability criteria and one or more categories of research eligible for expedited review, as indicated below.

Date of IRB Approval: March 12, 2013
Date of IRB Approval Expiration: March 12, 2014
Expedited Review Category: 7

If applicable, informed consent (and HIPAA research authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. The IRB-approved consent form and process must be used. Changes in the research (e.g., recruitment procedures, advertisements, enrollment numbers, etc.) or informed consent process must be approved by the IRB before they are implemented (except where necessary to eliminate apparent immediate hazards to subjects).

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It is the responsibility of all investigators and research staff to promptly report to the IRB any serious, unexpected and related adverse events and potential unanticipated problems involving risks to subjects or others.

This approval is issued under The Ohio State University's OHRP Federalwide Assurance #00006378. All forms and procedures can be found on the ORRP website – www.orrp.osu.edu. Please feel free to contact the IRB staff contact listed above with any questions or concerns.

Karla Zadnik, OD, PhD, Chair
Biomedical Sciences Institutional Review Board

APPENDIX I

MALONE UNIVERISTY IRB FORMS



Human Research Committee/IRB
Malone University
2600 Cleveland Ave., NW
Canton, Ohio 44709

March 1, 2013

RE: Protocol SWir/DISS#1 (Exercise Science Researcher: Steve Wirick)
"The Promotion of Regular Exercise Behavior Among Sedentary Emerging Adults Based On Social Cognitive Theory"

Cross-Ref: The Ohio State University, PI, Faculty Supervisor: Brian Focht, Ph.D.

Dear Professor Wirick and doctoral supervisor Brian Focht:

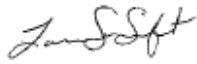
Thank you for sending us your proposal for research regarding promotion of regular exercise among adults in Canton, Ohio. Thank you for responding to our request for amendments to your participant consent form. We have received notification of cooperation of the Wellness Center at Malone University (Ref: email from Joyce Byler, Director, 2/28/13) and notification of Administrative approval by Malone University (Ref: email from Provost Donald Tucker, 2/28/13).

Because your study involves physical exercise (which may always carry some degree of risk to participants), it received a full committee review by the Human Research Committee/IRB at Malone University. The risk to participants is reduced through: (1) detailed informed consent forms, and (2) emergency notification procedures. Therefore, the HRC/IRB at Malone University has approved this study.

Please, let the Human Research Committee/IRB know if there are any changes to the project, or if there are any adverse events associated with the study. The approval instantiated in this letter is in effect for one year from the date on this letter and is renewable. Please, be aware that the Human Research Committee and Malone University do not accept responsibility for risks associated with the study. Responsibility rests with the researcher(s). It is the responsibility of researchers to be aware of local, state, and federal laws that apply to their methods, techniques, research, and record-keeping practices (e.g., 45 CFR 46; 21 CFR; HIPAA; FERPA).

Please, contact me with any questions you might have at 330-471-8558 or at LSEIFERT@malone.edu

Best regards,

Lauren S. Seifert, Ph.D. 
Chair, Human Research Committee/IRB;
Professor of Psychology,
Malone University